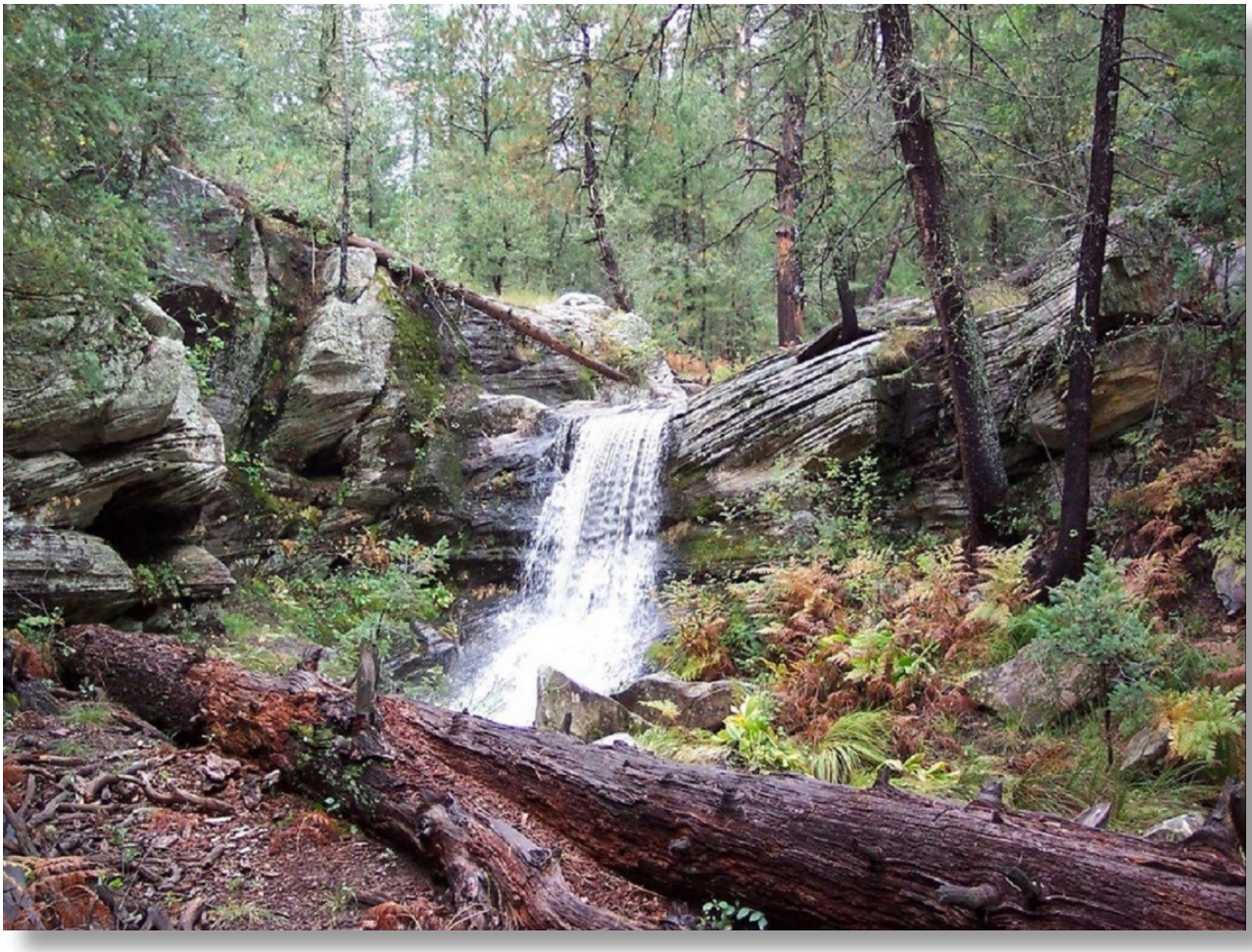
United States Department of Agriculture

Coconino National Forest Land and Resource Management Plan

Final Environmental Impact Statement

Volume I. Chapters 1, 2, and first half of chapter 3



Forest Service

Coconino National Forest

Southwestern Region

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Final Environmental Impact Statement for the Coconino National Forest Service Land and Resource Management Plan

Coconino, Gila, and Yavapai Counties, Arizona

Volume I. Chapters 1, 2, and first half of chapter 3

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Abstract: To comply with the National Forest Management Act and address changes that have occurred over the past 30 years, the Coconino National Forest proposes to revise the current land management plan (1987 plan). This programmatic final environmental impact statement (FEIS) documents analysis of the impacts of four alternatives developed for programmatic management of the 1.8 million acres administered by the Coconino National Forest. The analysis displays the anticipated progress toward the desired conditions as well as the potential environmental and social consequences of implementing each alternative. Alternative A is the no-action alternative, which is the1987 forest plan, as amended. Alternative B (modified) is the preferred alternative and is reflected in the accompanying Final Land and Resource Management Plan for the Coconino National Forest. This alternative addresses new information and concerns received since the 1987 forest plan was published, and it meets objectives of Federal laws, regulations, and policies. Alternative C considers increases in the amount of wilderness and special areas, as well as increased opportunities for semiprimitive recreation. Alternative D considers fewer restrictions on human access, use, and infrastructure.

Summary

This final environmental impact statement (FEIS) documents the analysis of alternatives developed for the programmatic management of the approximately 1.8 million acres administered by the Coconino National Forest (forest). The selected alternative will replace the 1987 Coconino National Forest Land and Resource Management Plan, as amended (1987 plan) that guides all natural resource management activities on the Coconino National Forest. The revised plan is intended to address new information and concerns raised since the 1987 plan was published; meet the objectives of Federal laws, regulations, and policies; address the changes in management anticipated to be needed over the next 15 years based on the analysis of the management situation; provide for clear direction in the form of desired conditions, objectives, standards, guidelines, suitability, management areas, and monitoring; incorporate the best available science; and provide a framework for adaptive management.

This FEIS discloses the detailed analysis of each of the four alternatives for revising the 1987 plan. The analysis displays the anticipated progress toward the desired conditions as well as the potential environmental and social consequences of implementing each alternative. Alternative A is the no-action alternative, which would continue management under the 1987 plan. Alternative B (modified) is the proposed revised plan. Alternative C is similar to alternative B (modified), but it includes the recommendation of additional wilderness areas and additional management areas that provide additional protections to botanical and wildlife resources. Alternative D is also similar to alternative B (modified), but in contrast to alternative C, it recommends no new wilderness areas and it provides additional access for mechanized recreation (e.g., mountain bikes) and energy infrastructure.

The Notice of Availability announcing the release of the proposed plan and draft environmental impact statement was published in the Federal Register on December 20, 2013, which initiated a 90-day public comment period. Public meetings were held in January 2014, in Flagstaff, Sedona, and Happy Jack, Arizona, and again in February 2014, in the same locations. Over 1,700 comment letters were received from individuals, organizations, agencies, and two tribes. These comments led to numerous changes throughout the revised plan and environmental impact statement, all of which were within the scope of the analysis in the draft environmental impact statement.

Final Environmental Impact Statement for the Coconino National Forest Service Land and Resource Management Plan

Volume I. Chapters 1, 2, and first half of chapter 3

Contents

Summary i
Commonly Used Acronyms ix
Chapter 1. Plan Revision Needs for Change 1
Document Structure 1
Summary of Changes from the Draft Environmental Impact Statement and the Alternatives 2
Location 5
Background 6
Needs for Change 6
Revision Topic 1: Recreation 6
Revision Topic 2: Community-Forest Interaction 7
Revision Topic 3: Maintenance and Improvement of Ecosystem Health 7
Proposed Action 8
Plan Decisions 8
Scope of the Analysis 9
Decision Framework 9
Public Involvement 10
Issues 11
Recreation Issues 11
Use/Management Issues 11
Wildlife or Ecosystem Issues 11
Issues Already Decided by Law, Regulation, or Policy 12
Chapter 2. Alternatives 13
Introduction 13
Process Used to Develop Alternatives 13
Renewable Resources Planning Act Program 18
Alternatives Eliminated from Detailed Study 18
Alternatives Considered in Detail 21
Elements Common to All Alternatives 21
Desired Conditions 22
Management Areas 22
Monitoring Strategy 22
Roadless Area Conservation Rule 22
Wilderness 23
Wildland-urban Interface 23
Alternative A (1987 plan) 23
Alternative B (modified) – Proposed Revised Plan 24
Alternative C 27
Alternative D 28
Forest Service's Preferred Alternative 28
Alternatives Comparison 29

Chapter 3. Affected Environment and Environmental Consequences 49
Assumptions 49
Cumulative Effects Common to All Resources 50
Air Quality 51
Watersheds and Water 66
Riparian Areas 89
Soil 110
Biophysical Features 153
Geological Features 153
Paleontological Resources 166
Vegetation and Fire 174
Climate Change 283
Recreation 289
The Recreation Setting 289
Recreation Activities and Facilities 296
Non-motorized and Motorized Recreation 300
Trails 309
Recreation Suitability 315
Recreation Special Uses 318
Special Areas 324
Wilderness and Wild and Scenic Rivers 324
Inventoried Roadless Areas 333
National Trails and Scenic Roads 334
Research Natural Areas and Botanical and Geological Areas 337
Environmental Study Areas 343
Scenic Resources 345
Mineral Resources 362
Fire Management 385
Forest Products 392
Heritage Resources 401
Tribal Relations 412
Infrastructure and Facilities 415
Lands and Special Uses 426
Livestock Grazing 441
Socioeconomic Analysis 458
Short-term Uses and Long-term Productivity 482
Air Quality 483
Vegetation 483
Scenic Resources 483
Mineral Resources 484
Infrastructure and Facilities 484
Lands 485
Unavoidable Adverse Effects 486
Irreversible and Irretrievable Commitments of Resources 486
Adaptive Management 486
Other Required Disclosures 487
Volume I Index 489

List of Tables

Table 1. Comparison of alternatives 30
Table 2. Summary of effects 43
Table 3. Summary of watershed condition for 6th code watersheds (number in each condition class) 68
Table 4. Streamflow trend by watershed 70
Table 5. 4th code watersheds and percent ownership 88
Table 6. PFC Classes (miles and percent) by stream riparian length in 4th and 5th HUC watersheds on forest-administered lands 92
Table 7. Riparian forest condition, departure, and trend on forest-administrated land 97
Table 8. Summary of stream riparian function departure values and trends 100
Table 9. Summary of departure values and trend by alternative for wetlands 106
Table 10. Summary of departure values and trend by alternative for springs 107
Table 11. Current departures and trends of soil condition class from reference condition by ERU or riparian areas within lands managed by the Coconino NF 113
Table 12. Estimated trends in soil condition/productivity for each ERU or riparian forest type by alternative 116
Table 13. Acres of open states in Ponderosa Pine, Pinyon Juniper with Grass, and Mixed Conifer Frequent Fire ERUs 122
Table 14. Plan objectives by alternative that would reduce fuel loading 123
Table 15. Ecological response units and riparian areas on the forest 174
Table 16. Acres burned by ERU 176
Table 17. Summary of vegetation and fire changes compared to reference conditions, ERU threats, and departure characteristics 177
Table 18. Existing and desired number of snags by ERU 179
Table 19. Existing and recommended wilderness areas within each ERU and riparian areas under the action alternatives 195
Table 20. Acres by ERU on which uncharacteristic fire would be reduced for each alternative 200
Table 21. Short-term and long-term vegetation departure rating and trend relative to reference condition by alternative (for both low and high treatment objectives in applicable ERUs) 209
Table 22. Fire return interval departure and trends for all ERUs under all alternatives 210
Table 23. Desired, existing, and expected distribution of Ponderosa Pine states - All alternatives .. 215
Table 24. Effects of different treatment levels on the amount of vegetation departure within suitable and unsuitable areas for all alternatives 216
Table 25. VDDT modeled Ponderosa Pine vegetation states expected under all alternatives (A, B (modified), C, and D) based on the low and high objectives 218
Table 26. Predicted snag density by size class in Ponderosa Pine under all alternatives (A, B (modified), C, and D 221
Table 27. Alternative A departure in suitable and unsuitable timberlands over time in Mixed Conifer Frequent Fire ERU 227
Table 28. VDDT modeled output for Mixed Conifer with Frequent Fire ERU under alternative A on both suitable and non-suitable timberlands combined 228
Table 29. Predicted snag density by size class in Mixed Conifer with Frequent Fire under alternative A 229
Table 30. Effects of different treatment levels on the amount of vegetation departure within suitable and unsuitable areas in Mixed Conifer with Frequent Fire for alternatives B (modified), C, and D 232
Table 31. VDDT modeled output for Mixed Conifer with Frequent Fire ERU on suitable and non-suitable timberlands combined for alternatives B (modified), C, or D 233
Table 32. Predicted snag density by size class in Mixed Conifer with Frequent Fire under alternatives B (modified), C, and D 237
Table 33. VDDT modeled output for Pinyon Juniper Grassland ERU under alternative A 240

Table 34. Predicted snag density by size class in Pinyon Juniper with Grass ERU under alternative A 241
Table 35. VDDT modeled output for Pinyon Juniper with Grass ERU under alternatives B (modified), C, and D 243
Table 36. Pinyon Juniper with Grass estimated average of snags per acre under alternatives B (modified), C, and D 244
Table 37. VDDT modeled output for Semi-desert Grassland ERU (under alternatives B (modified), C, and D 250
Table 38. VDDT modeled output for Great Basin Grassland ERU under alternative A 252
Table 39. VDDT modeled output for Great Basin Grassland ERU (low and high objectives) under alternatives B (modified), C, and D 254
Table 40. VDDT modeled output for Montane/Subalpine Grassland ERU under alternatives B (modified), C, and D 256
Table 41. Key climate change factors and relevant plan direction 287
Table 42. Percent of forest in recreation opportunity spectrum classes (per 2011 inventory) 290
Table 43. Percent of forest by recreation and wilderness opportunity spectrum settings 292
Table 44. National visitor use monitoring survey visitation estimates 2005 and 2010[1] 296
Table 45. Developed facilities on the Coconino NF by type 297
Table 46. Miles of vehicle-type designations on the 2014 motor vehicle use map 302
Table 47. Recreation suitability acreages by alternative 316
Table 48. Recommended wilderness 325
Table 49. Summary of eligible wild and scenic rivers on the Coconino NF 325
Table 50. Inventoried roadless areas on the Coconino NF 333
Table 51. Existing scenic integrity level acres 348
Table 52. Visual quality objectives allocated in the 1987 plan 353
Table 53. Proposed scenic integrity objectives 354
Table 54. Scenery rehabilitation acreage 355
Table 55. Acres of scenic integrity objectives or visual quality objectives 358
Table 56. Indicators for scenery 359
Table 57. Existing withdrawals, new wilderness, and special areas (acres) considered for withdrawal by alternative 371
Table 58. Alternative B (modified), mineral commodity or energy resources in recommended wilderness or other special area status 377
Table 59. Alternative C, mineral or energy resources in areas proposed for wilderness designation or other special area status 381
Table 60. Estimated 5-year average of annual forest product removal and availability, by alternative 394
Table 61. Categories of lands not appropriate for timber production and the alternative-specific attributes that would result in lands not appropriate 395
Table 62. Calculations for acres of lands not appropriate for timber production by alternative 396
Table 63. Average annual allowable sale quantity and long-term sustained yield capacity, volumes (CCF) by alternative 397
Table 64. Expected maximum harvest levels per decade 397
Table 65. Estimated number of additional archaeological sites within recommended wilderness or proposed special area designation by alternative 407
Table 66. Miles of public and administrative roads within recreation opportunity spectrum (ROS) classifications by alternative 419
Table 67. Acres suitable for future consideration of new motorized areas, National Forest System roads, and temporary roads under alternatives B (modified), C, and D[1] 421
Table 68. Potential public use road miles suitable for closures within wildlife habitat management areas (alternative C)[1] 423

Table 69. Comparison of effects to sediment delivery based on level of traffic and maintenance level 424
Table 70. Permitted and annually authorized livestock use, grazing years 2004 through 2014[1] 442
Table 71. Portions of allotments permanently removed from grazing 444
Table 72. Population change: 1990 to 2000 and 2000 to 2010 460
Table 73. Population density 461
Table 74. Median age 462
Table 75. Gender distribution 462
Table 76. Educational attainment, percentage of adults age 25 and over 463
Table 77. Forest activity participation 464
Table 78. Percentage of residents living in poverty 466
Table 79. Per capita income, 2009 U.S. dollars 467
Table 80. Median earnings for workers, 2009 U.S. dollars 468
Table 81. Contribution of labor and non-labor income to total personal income, 2000 and 2009 468
Table 82. Annual unemployment rate, 2001 through 2010 469
Table 83. Median value of owner-occupied homes, 2009 U.S. Dollars 469
Table 84. Payments to the State and counties from the Coconino NF 473
Table 85. Estimated employment by program area by alternative 474
Table 86. Estimated labor income by program area by alternative 475
Table 87. Estimated annual forest product volumes by alternative 475
Table 88. Estimated annual Coconino NF program expenditures, by alternative (FY 2008 to FY 2010) 478
Table 89. Estimated annual Coconino NF program revenue, by alternative (FY 2008 to FY 2010) 478
Table 90. Estimated present net value by alternative and program area (15-year period) 479
Table 91. Nonmarket values, acres by alternative (percentages indicate percent of total Coconino National Forest acreage) 481
Table 92. Road mileage within non-motorized areas by alternative 485

List of Figures

Figure 1. Coconino National Forest vicinity map 5
Figure 2. Arizona smoke management map 52
Figure 3. Cumulative effects for smoke impacts 64
Figure 4. Relative departure from desired conditions, resilience and ecosystem health by alternative 207
Figure 5. Recreation opportunity spectrum 289
Figure 6. Miles of trail by condition class and trail use design (USDA Forest Service 2017b) 310
Figure 7. Mineral districts and mineral favorability on the Coconino National Forest 365
Figure 8. Vicinity map of the Coconino National Forest 459
Figure 9. Race and ethnicity 466
Figure 10. Employment by industry in the study area 470
Figure 11. Employment by industry in Arizona 471
Figure 12. Sectors with relatively higher rates of employment in study area 472

Commonly Used Acronyms

ADEQ – Arizona Department of Environmental Quality

ADOT – Arizona Department of Transportation

AMS – analysis of the management situation

ASQ – allowable sale quantity

AUM – animal unit month

AZGFD – Arizona Game and Fish Department

BA – basal area

BLM – Bureau of Land Management

CCF – hundred cubic feet

CFR – Code of Federal Regulations

CLF – Chiricahua leopard frog

CWD – coarse woody debris

d.b.h. – diameter at breast height

d.r.c. – diameter at root collar

EPA – Environmental Protection Agency

ESA – Endangered Species Act

ESR – ecological sustainability report

ERU – ecological response unit

FACTS – Forest Service ACtivity Tracking System

FPR – forest plan revision

FR – forest road

FRCC – fire regime condition class

FSH – Forest Service Handbook

FSM – Forest Service Manual

FVS – Forest Vegetation Simulator

FY – fiscal year

GA – geological area

GFA – general forest area

GIS – geographic information system

HUC – hydrologic unit code

IBA – important bird area

IMPLAN – IMpact Analysis for PLANning

IRA – inventoried roadless area

LRMP – land and resource management plan

LTSYC – long-term sustained yield capacity

MA – management area

MBF – thousand board feet

MCF – thousand cubic feet

MIS – management indicator species

MSO – Mexican spotted owl

MVUM – motor vehicle use map

NAAQS – National Ambient Air Quality Standards

NEPA – National Environmental Policy Act

NF – national forest

NFMA – National Forest Management Act

NFS – National Forest System

NPS – National Park Service

NVUM – National Visitor Use Monitoring

OHV – off-highway vehicle

ORV – outstandingly remarkable values

P – primitive

PAC – protected activity center

PAOT – persons-at-one-time

PFC – proper functioning condition

PNV – present net value

ERU – potential natural vegetation type

R – rural

RASES – Riparian Area Survey and Evaluation System

RMAP – Regional Riparian Mapping Project

RN – roaded natural

RNA – research natural area

ROS – recreation opportunity spectrum

SIO – scenic integrity objective

SMS – Scenery Management System

SMU – smoke management unit

SPNM – semiprimitive nonmotorized

TES – terrestrial ecosystem survey

TMDL – total maximum daily load

TMR – Travel Management Rule

TPA – trees per acre

U – urban

USDA – U.S. Department of Agriculture

USDI – U.S. Department of the Interior

USGS – U.S. Geological Survey

VCC – vegetation condition class

VDDT – Vegetation Dynamic Development Tool

VSS – vegetative structural states

VQO – visual quality objective

WHMA – wildlife habitat management area

WOS – wilderness opportunity spectrum

WUI – wildland-urban interface

Chapter 1. Plan Revision Needs for Change

Document Structure

The Forest Service has prepared this final environmental impact statement (FEIS) in compliance with the National Environmental Policy Act (NEPA) (P.L. 91-190) and other relevant Federal and State laws and regulations. This FEIS discloses the indirect and cumulative environmental impacts that would result from the proposed action (proposed revised plan) and alternatives. The document is organized into four volumes:

Volume I

- *Chapter 1. Plan Revision Needs for Change*: Includes information on the needs for change which were identified during the early stages of plan revision and the Agency's proposed revised plan for addressing those needs for change. This chapter also details how the Forest Service informed the public of the proposed revised plan and how the public responded.
- *Chapter 2. Alternatives:* Provides a more detailed description of the proposed revised plan as well as alternative methods for addressing the needs for change. It also provides tables that compare the alternatives and summarize the environmental consequences associated with each alternative.
- *Chapter 3. Affected Environment and Environmental Consequences:* Summarizes the physical, biological, social, and economic environments affected by the proposed revised plan and the environmental consequences of implementing the proposed revised plan and other alternatives on these environments. Volume I includes analysis for all of the resource topics except Wildlife, Fish, and Plants, which is included in Volume II.

Volumes IIa and IIb

- *Chapter 3. Affected Environment and Environmental Consequences:* Summarizes the physical, biological, social, and economic environments affected by the Revised Plan and the environmental consequences of implementing the Revised Plan and other alternatives on these environments. Volume II includes analysis for Wildlife, Fish, and Plants; all other resource topics are included in Volume I.
- *Chapter 4. Consultation and Coordination:* Lists preparers and agencies consulted during the FEIS development.
- *Glossary*. Provides explanations for key concepts in the FEIS.
- *References*. Provides citations for references made in the FEIS.
- *Index*. Provides page numbers by topic.

Volume III

- *Appendix A. Maps:* Includes maps of the Coconino NF that display the variations in management across the alternatives.
- *Appendix B. Public Collaboration and Involvement/Other Planning Efforts:* Demonstrates how the Coconino NF integrated the public, stakeholders, and adjacent landowners into the various phases of its land management plan revision effort.

- *Appendix C. Methodology and Analysis Process:* Provides supplemental information about assumptions, data sources, and/or methodologies used for the analysis in chapter 3 of the FEIS.
- *Appendix D. Response to Comments:* Includes responses to the comments submitted for the Draft Land and Resource Management Plan and the Draft Environmental Impact Statement during the 90-day comment period that ended in March 2014.
- *Appendix E. Other 1982 Planning Rule Provisions:* Includes information for the remaining 1982 planning rule provisions and other planning related requirements that are not satisfied in the main body of the FEIS.
- *Appendix F. Forest Plan Language for Alternatives:* Provides specific plan language for alternatives C and D.
- *Appendix G. Timber Sale Schedule, Financial Evaluation, Allowable Sale Quantity, Long-Term Sustained Yield, and Timber Suitability Calculation:* Provides additional information and analysis for the methodologies related to timber production and harvesting as required by the National Forest Management Act and the 1982 planning rule provisions.
- *Appendix H. Other Supporting EIS Documentation:* Provides a list of other documents that were used extensively in developing the Revised Plan.

Volume IV

- *Appendix I. Crosswalk between Coconino 1987 Forest Plan (as amended) and the Revised Forest Plan:* Provides a crosswalk and explanation of how existing plan direction (e.g., standards and guidelines) in the 1987 Forest Plan was incorporated into the revised plan.

Additional documentation, including specialist reports, which contain more detailed analyses, may be found in the project record.

Summary of Changes from the Draft Environmental Impact Statement and the Alternatives

In response to comments received during the 90-day comment period on the draft environmental impact statement (DEIS) and proposed revised plan, a number of changes have been made in the FEIS and to alternatives B (proposed revised plan) and C. The adjustments to the structure and language in these alternatives were made to make the plan easier to use, remove duplicative plan language, clarify or elaborate on plan language, and add new plan language. Additional information on these comments that generated these changes and the Forest's responses to those comments may be found in Appendix D of this FEIS.

Changes made to the Environmental Impact Statement include:

- An additional alternative was considered but not given detailed study, as disclosed in Chapter 2.
- The analysis was updated to reflect changes resulting from the 2013 Regional Forester's sensitive species list.
- Appendix I was added to provide greater transparency on how key existing plan direction (e.g., standards and guidelines) were incorporated into the Revised Plan.
- Other changes to the FEIS include corrections or additions to terminology, methodology, and effects to improve clarity and changes in organization to make the document easier to use.

Changes made to alternative B (proposed revised plan) include:

- Adding and clarifying the descriptions for Plan Decisions (desired conditions, objectives, standards, guidelines, suitability, and monitoring) in Chapter 1;
- Reorganizing General Description and Background for consistency in most sections;
- Consolidating broad ecosystem-wide plan direction from a variety of resource sections into a new section called All Ecosystems;
- Adding a description of and plan direction for karst to the Biophysical Features section;
- Reorganizing the plan direction in the Water Quality, Water Quantity, and Aquatic Systems section into new sections called Watersheds and Water, Constructed Waters, and Riparian Areas;
- Reorganizing the plan direction in the Vegetation section by renaming the section Terrestrial ERUs and moving the plan direction on Riparian Types into the new section called Riparian Areas.
- Updating desired conditions on ERUs in the renamed Terrestrial ERUs section to align with most current information and renaming ERUs as ecological response units (ERUs);
- Consolidating the plan direction on wildland-urban interfaces into a new section called Wildland-urban Interface;
- Renaming the Energy and Minerals section to Mineral Resources to more accurately identify the contents of the section;
- Reorganizing the Recreation section into new subcategories on All Recreation, Developed Recreation, Dispersed Recreation, and Trails and Trailheads;
- Consolidating the plan direction on interpretation and education into a new section called Interpretation and Education;
- Relocating the direction on specific areas from the forestwide direction sections to the appropriate Management Area direction;
- Expanding the General Description and Background sections for Management Areas to include more detailed information on the resources present in the Management Areas;
- Renaming the Fort Valley/Mount Elden Management Area as the Mount Elden Management Area;
- Renaming the Upper Clear Creek Management Area as the East Clear Creek Management Area;
- Reorganizing the overarching Sedona/Oak Creek Management Area direction into the Red Rock, Oak Creek Canyon, Sedona Neighborwoods, and House Mountain Management Areas, all of which contain the relevant language from the overarching Sedona/Oak Management Area;
- Renaming the Sedona/Oak Creek Management Area as the Red Rock Management Area;
- Reorganizing the plan direction on watersheds important for municipal water supplies into the C.C. Cragin Watersheds, Inner Basin, and Lake Mary Watersheds Management Areas;
- Expanding plan direction for the Verde Valley Management Area by stepping down forestwide direction from the Watershed, Recreation, and Riparian sections for specific application to the management area;

- Reorganizing the plan direction on Designated Wilderness Areas;
- Updating the Recommended Wilderness section to reflect the removal of the Walker Mountain potential wilderness area and inclusion of the Abineau potential wilderness area;
- Reorganizing the plan direction on Wild and Scenic Rivers;
- Reorganizing the National Trails and Scenic Byways section into separate sections called National Trails and Scenic Roads;
- Adding information on state scenic roads to the Scenic Roads section;
- Relocating the plan direction on quiet areas and seasonal closures into the management areas that overlap these quiet areas and seasonal closures;
- Adding a new section that addresses Inventoried Roadless Areas;
- Updating the discussion on grazing suitability in Chapter 4; and
- Updating the Recreation and Transportation Suitability table in Chapter 4 to reflect that mechanized and non-motorized travel would be suitable on designated trails within botanical and geological areas.

Several adjustments were made to elements of alternative B. Comments on the rationale for recommending the Strawberry Crater Addition, Walker Mountain, and Davey's potential wilderness areas as part of this alternative prompted a review of the potential wilderness evaluation process. After a thorough review of the available information, it was determined that the Walker Mountain potential wilderness area would not be carried forward in alternative B and the Abineau potential wilderness area that is included in alternative C would be added to the modified alternative B. The Walker Mountain potential wilderness area is still part of alternative C.

Alternative B was also modified to incorporate another element from alternative C. In addition to proposing the Cottonwood Basin Geologic Area, the modified alternative B now also includes the proposal for the adjacent Cottonwood Basin Botanical Area. The boundaries for both the geological and the botanical areas have been adjusted to coincide with range pasture boundaries in the area. This adjustment reduced the proposed geological area from 217 acres to 185 acres and the proposed botanical area from 1,635 acres to 578 acres. The combined Cottonwood Basin Geological and Botanical Area would have a total of 763 acres.

One of the recreation suitability determinations from alternative D has been incorporated into alternative B, too. Under the modified alternative B, mechanized travel would be allowed on designated system trails in botanical and geological areas, otherwise these areas are not suitable for mechanized travel.

Adjustments were made to plan language to address a wide range of comments. In some cases, plan direction was moved from one type of plan component to another. For example, plan direction in a desired condition may have been more appropriately included as a guideline. In other cases, several similar plan components may have been merged into one component. The desired conditions related to scenery were edited to remove language that merely described an area. This information was either moved to the appropriate General Description and Background section or to the Landscape Character Description document, a scenery inventory component for the Scenery Management System.

Due to these adjustments, the proposed revised plan that is being analyzed under alternative B in this FEIS is different from the proposed revised plan that was analyzed in the DEIS. To reflect this

change, the modified version of alternative B will be referred to as alternative B (modified) in this document. While alternative B (modified) is not the same as alternative B from the DEIS, all of the elements it contains were part of one of the four alternatives considered in the DEIS and within the scope of the analysis in the DEIS. Furthermore, the adjustments to alternative B have not resulted in a substantial change in the effects previously disclosed in the DEIS.

Changes made to alternative C were related to the names of some of the management areas. Several commenters questioned the appropriateness of naming eight of the management areas in the alternative as "Wildlife Habitat Management Areas." These commenters suggested that the management areas only restricted public motorized access and were not a comprehensive approach to wildlife habitat management. To address these comments, "Wildlife Habitat" was removed from the names of these management areas. In addition, the East Clear Creek Management Area was renamed the Blue Ridge Management Area. However, no plan components included in these eight management areas being added by alternative C were changed.

Location

The Coconino National Forest (hereafter referred to as the Coconino NF or forest) ranges in elevation from 2,600 to 12,633 feet. The northern part of the forest is dominated by the San Francisco Peaks, which includes the highest point in Arizona. The forest is located at the southern end of the Colorado Plateau and is one of six national forests in Arizona, sharing boundaries with the Apache-Sitgreaves, Kaibab, Prescott, and Tonto National Forests. (See figure 1.) The forest is steward to lands that are considered central to the way of life of 13 southwestern American Indian tribes. The Navajo and Hopi Nations, in particular, are prominent neighbors north and east of the forest. Private land, as well as lands administered by the State of Arizona and National Park Service, abuts the forest. The Grand Canyon National Park, while not immediately adjacent to the forest, is an economic driver for communities in and around the forest.

Figure 1. Coconino National Forest vicinity map

Background

The existing "Land and Resource Management Plan for the Coconino National Forest" (1987 plan or forest plan) was completed in 1987. The 1987 plan, including its amendments, is the main document that guides forest managers' decisionmaking with respect to managing natural resources (e.g., soil, water, vegetation, and ecosystems) and human uses (e.g., recreation, thinning, livestock grazing, firewood gathering, special use permits, and search for solitude) of the Coconino NF.

Per direction in the National Forest Management Act of 1976 and its implementing regulations found in 36 Code of Federal Regulations (CFR 219) (1982), every national forest must revise its land management plan:

- Every 10 to 15 years;
- When conditions or demands in the area covered by the forest plan have changed significantly;
- When changes in agency policies, goals, or objectives would have a significant effect on forest-level programs; and
- When monitoring and evaluation indicate that a revision is necessary.

Because the 1987 plan is outdated and does not reflect current conditions, the Coconino NF has been engaged in the process of revising its plan since 2006. During this process, the Coconino NF developed multiple programmatic strategies (or alternatives) for revising the plan.

Needs for Change

The purpose of this FEIS is to evaluate the different alternatives for revising the 1987 plan, including disclosure of their potential environmental consequences.

In preparation for plan revision, the Coconino NF identified guidance in the 1987 plan that is working, new conditions that need to be addressed, and ongoing challenges that could be better addressed. This preparatory work is documented in the "Analysis of the Management Situation," which was completed in May 2010 (USDA Forest Service 2010a). Through the "Analysis of the Management Situation," the Coconino NF identified current ecological and socioeconomic conditions and trends taking place on the forest and the associated "needs for change" to be addressed in the revised plan. The needs for change are grouped under three broad revision topics: (1) recreation, (2) forest community interaction, and (3) maintenance and improvement of ecosystem health.

There is a need to revise the 1987 plan to: (1) meet the legal requirements of the National Forest Management Act and the provisions of the 1982 Planning Rule,[1] (2) guide natural resource management activities on the forests for the next 10 to 15 years, and (3) address needed changes in management direction as identified in the three revision topics.

Revision Topic 1: Recreation

Conditions and Trends

Recreational use of the Coconino NF has changed significantly since the 1987 plan was developed. Some of the trends and conditions related to recreation include: increased use of developed

[1] The transition provisions (36 CFR 219) of the 2012 Planning Rule allow use of the 1982 Planning Rule to amend or revise plans.

recreation areas; changing demographics; increased conflicts in social values, culture, and expectations tied to public lands, for example between those who believe that only recreational activities that are less disruptive of nature (wildlife viewing or hiking) should occur on the forest and those who believe the forest should be equally available for all recreation types (hiking, off-road vehicle use, large group events); new types of recreation; the adoption of a new scenery management system; increased recognition of tribal cultural uses and values; and pressures on riparian, wilderness, and other special areas.

Needs for Change

To allow for changing trends and conditions, the proposed revised plan needs to:

- Update desired conditions and other plan components for recreation and scenery management where guidance is partial or absent in the 1987 plan,
- Update the plan components for existing special areas, and
- Incorporate special area recommendations and related plan components into the revised plan.

Revision Topic 2: Community-Forest Interaction

Conditions and Trends

Relationships with the surrounding communities have changed significantly since the 1987 plan was developed. Some of the trends and conditions related to forest–community interaction include: a shift from a commodity-based (timber, mineral development) to service-based (recreation) economy; the influence of forest management activities on the local economy and environment; population growth and loss of forest access or open space; and increased demand for community infrastructure.

Needs for Change

To allow for changing trends and conditions, the proposed revised plan needs to:

- Update plan language to acknowledge open space values,
- Update plan language to acknowledge potential future community growth and expansion desires,
- Update guidance on energy and mineral development,
- Provide guidance related to forest products and consideration of culturally important forest products,
- Clarify regulatory authorities relating to air quality and include approaches for addressing smoke and fugitive dust emissions, and
- Review and update plan guidance on communication sites.

Revision Topic 3: Maintenance and Improvement of Ecosystem Health

Conditions and Trends

Since development of the 1987 plan, there is new knowledge of forest ecosystems, and the emphasis of forest management has shifted from timber outputs to the maintenance and improvement of ecosystem health. Some of the trends and conditions related to ecosystem health include: recognition

of each ecological resource on the forest, from soil to wildlife; forest resilience; changed frequency and severity of natural disturbances in fire-adapted ecosystems; the decline of aspen; the loss of understory species; lack of current plan direction for rarer ecosystems (e.g., tundra, spruce-fir, and riparian); susceptibility to uncharacteristic disturbances (e.g., fire, drought, and insects and disease); climate change; invasive species; and habitat connectivity.

Needs for Change

To allow for changing trends and conditions, the proposed revised plan needs to:

- Update desired conditions and objectives for soil resources,
- Integrate and update management direction for riparian, aquatic, and water resources,
- Incorporate desired conditions that reflect the composition, structure, and natural disturbance attributes characteristic of the different ecosystems, and integrate desired conditions across different resource areas,
- Address invasive exotic flora and fauna,
- Ensure plan components address concerns of forest analysis species[2] and their habitat,
- Address habitat connectivity, and
- Integrate strategies to address effects of climate change.

Proposed Action

The Forest Service proposes to revise the existing land management plan for the Coconino NF. Proposed changes to the forest plan include updates to the desired conditions, objectives, standards, guidelines, special areas, suitability, and monitoring requirements that will guide management of the Coconino NF for the next 10 to 15 years. The proposed revised plan changes the description and allocation of the management areas to move toward forestwide desired conditions and to provide opportunities for a range of activities. The proposed revised plan focuses on the three revision topics identified above and incorporates significant issues raised during the scoping process where it was feasible to do so. It accompanies this document.

Plan Decisions

The Revised Plan includes “plan decisions” and “other content.” Once plan decisions are approved, any substantive changes to them will require a plan amendment. A change to “other content” may be made using an administrative correction process. Administrative corrections are also used to make nonsubstantive changes to plan decisions such as data and map corrections, or updates and typographical errors. The public will be notified of all plan amendments and administrative corrections.

Plan decisions are the equivalent of plan components. They include desired conditions, objectives, standards, guidelines, management areas, special areas, suitability, and monitoring. The following is a description of the types of plan components:

- Desired conditions set forth the desired social, economic, and ecological goals of the Coconino NF and objectives express quantifiable aspirations for working toward the desired conditions.

[2] Forest analysis species are plant, animal, and aquatic species considered for analysis during the forest plan revision process.

These plan components form the basis for prioritizing and designing projects, activities, and uses that occur under the forest plan.

- Suitability determinations, standards, and guidelines set requirements to limit or guide forest uses or activities that are expected to occur under the forest plan.
- Management area and special area designations, or recommendations for special area designations (e.g., recommended wilderness areas), identify spatially defined areas with management direction specific to that area and must be carried out in addition to the forestwide plan components.
- Monitoring and evaluation requirements are used to determine the degree to which on-the-ground management is maintaining or making progress toward desired conditions.

In the Revised Plan, a code is used to reference and visually distinguish plan decisions more easily. Abbreviations are used in each code to identify: (1) if a plan decision applies forestwide (FW) or within a particular management (MA) special (SA) area; (2) resource area; and (3) type of plan decision. The last part of each code is a number. For example "FW-Air-Qual-DC-1" refers to the forestwide direction for air quality, desired condition number 1; "MA-FlagN-O-2" refers to the management area direction for Flagstaff Neighborwoods, objective number 2; "SA-WSR-Verde-S-1" refers to the special area direction for the Verde Wild and Scenic River, standard number 1. Plan codes are used throughout the analysis in the FEIS.

While the forest plan strategically guides future management of the forest, it does not authorize projects or make site-specific project decisions. Those decisions are made following project-specific proposals and in conjunction with separate, site-specific NEPA analysis, with additional opportunities for public involvement.

Further information and more detailed descriptions of the plan components are found in chapter 1 of the Revised Plan under the section "Plan Content." Information on how project-level planning will implement the plan components is found in chapter 1 of the Revised Plan under the section "Future Projects, Program Plans, and Assessments."

Scope of the Analysis

The analysis in this FEIS is limited to the needs for change revision topics listed above and to those significant issues (discussed below). Many issues raised during the scoping process are beyond the scope of this plan revision process and will not be considered in the FEIS. For example, issues associated with site-specific activities that are addressed by project-level decisions are not addressed. The designation of specific routes, trails, and areas for motorized vehicle travel will not be considered during plan revision because it is addressed in the separate environmental impact statement for public motorized travel planning on the Coconino NF (USDA Forest Service 2011e). Some issues (e.g., hunting regulations), although important, are beyond the authority or control of the Coconino NF and will not be addressed. In addition, some issues, such as wild and scenic river suitability determinations, will not be undertaken at this time, but will be addressed in the future in separate analyses.

Decision Framework

The regional forester for the Southwestern Region will make the final decision on the selected alternative for the proposed revised plan. The regional forester will review the proposed action (proposed revised plan), the other alternatives (A, C, and D), and the environmental consequences of each, then decide which plan alternative, or combination of alternatives, best addresses the identified

needs for change, issues raised during the scoping process, the desired conditions, multiple use concept, diverse needs of people, and sustainable management of the Coconino NF as well as the requirements of the National Forest Management Act (P.L. 94-588) and the Multiple Use-Sustained Yield Act (P.L. 86-517).

Public Involvement

Informal public involvement began in mid-2006. Public meetings, information in the "Coconino National Forest Annual Stakeholders Report," letters, emails, phone calls, radio announcements, and postings to the Coconino National Forest website were used to share and gather information and encourage participation in the plan revision process. Plan revision team members also gave presentations, went to the field, and met with individuals and groups. Four topic-based workgroups were also formed to focus on special areas and socioeconomic, ecological, and species diversity. Information collected from the public was used to identify the needs for change. Topics brought forward by the public and other agencies were summarized in the "Analysis of the Management Situation" and presented to the Coconino National Forest leadership team. These topics included: species diversity, special management areas, livestock grazing, roads and trails, fuel reduction, forest products and industry, water and riparian areas, open space, land exchanges, and places of interest.

The notice of intent to prepare an EIS was published in the Federal Register on May 12, 2010. The notice of intent, which formally initiated the scoping process, requested public comment on the plan needs for change from May 12 through June 30, 2010.

After publication of the notice of intent, the Coconino NF held two rounds of open house or workshop style public meetings—one round in November 2010 and another in March 2011—to: (1) provide information on the current status of plan revision, (2) present and discuss language in the proposed revised plan, (3) receive input regarding whether the proposed revised plan adequately addressed the needs for change, and (4) identify other issues and concerns that still needed to be addressed. Public meetings were held in Flagstaff, Cottonwood, Happy Jack, and Camp Verde. The plan revision team also held "office hours" at locations in Flagstaff, Happy Jack, and Sedona to allow additional opportunities for the public to discuss the proposed revised plan with plan revision team members in a more one-on-one setting. Public input gathered from these meetings, as well as from written comments, was used to identify concerns that led to further refinement of the proposed revised plan as detailed in chapter 2. Those comments that could not be addressed through making adjustments to the proposed revised plan were carried forward as issues and used to develop alternatives.

A notice of availability was published in the Federal Register (78 FR 77121) on December 20, 2013, initiating the formal 90-day comment period on the DEIS and proposed forest plan as required by Forest Service National Forest Management Act regulations. Over 1,700 comment letters were received from individuals, organizations, agencies, and two tribes. These comments led to numerous changes throughout the proposed forest plan and environmental impact statement, all of which were within the scope of the analysis in the DEIS. The changes to the proposed forest plan and alternative C are discussed in the Addressing Concerns Raised During 90-Day Comment Period sections under alternatives B and C in chapter 2.

Tribal consultations on plan revision included 13 American Indian tribes that have a special connection with the area encompassed by the Coconino NF: the Fort McDowell Yavapai Nation, the Hopi Tribe, the Hualapai Tribe, the Havasupai Tribe, the Navajo Nation, the Pueblo of Acoma, the Pueblo of Zuni, the San Carlos Apache Tribe, the San Juan Southern Paiute Tribe, the Tonto Apache Tribe, the Yavapai-Apache Nation, Yavapai-Prescott Tribe, and the White Mountain Apache Tribe.

The Forest first notified the above tribes in September 2006, with a letter announcing the start of the revision process and the dates for the first round of public meetings. Information sharing has continued throughout the plan revision process. In addition to written and electronic communications to the tribes, 6 multi-tribal meetings and 8 individual tribal meetings were held to discuss forest plan revision.

Eligibility to appeal the regional forester's decision regarding the selected alternative is limited to persons and organizations that comment on the EIS or otherwise express an interest in the project during the formal 90-day comment period.[3]

Issues

Comments were received from the public, other agencies, and tribes in response to the notice of intent comment period and public meetings. The comments were analyzed to identify issues and frame their associated cause-and-effect relationships. Issues not identified as those already addressed by law or regulation, the proposed revised plan, other higher level decision, or those already covered by the 1987 plan were used to develop alternatives. Using comments from the public, other stakeholders, agencies, and tribes, the plan revision team developed the following list of issues to address in the environmental analysis. For details on how these issues were specifically addressed, see the "Alternatives Considered in Detail" section of chapter 2.

Recreation Issues

- Mechanized use on trails may create no more impact than foot traffic in botanical and geological areas, so it should not warrant prohibition.
- Some recreation activities in the proposed revised plan, such as snowmobile use and recreational shooting, may cause noise and disturb other, different recreational activities and recreation settings.
- The proposed revised plan may not adequately meet the demand for wilderness areas and their associated primitive, undeveloped settings.

Use/Management Issues

- In the proposed revised plan, grazing may negatively impact the values for which research natural areas were designated.
- Recommending additional wilderness areas in the proposed revised plan would unnecessarily prohibit and further geographically constrain management activities and uses that would otherwise be allowed.
- Language in the proposed revised plan might unnecessarily restrain access/use of the forest for future energy infrastructure needs.

Wildlife or Ecosystem Issues

- The proposed revised plan may not fully address disturbance of wildlife species from motor vehicle traffic in areas on the forest.
- The proposed revised plan may not adequately promote habitat connectivity, nor promote the identification or removal of potential barriers to wildlife movement.

[3] Optional appeal procedures available during the planning rule transition period allowed by Title 36 CFR Part 219 subpart A.

- Old-growth forest components are underrepresented on the landscape and were better provided for in the 1987 plan than in the proposed revised plan.

Issues Already Decided by Law, Regulation, or Policy

Issue: *The proposed revised plan may not contain sufficient guidance to adequately protect quality and quantity of groundwater.*

Rationale: Water withdrawal is under forest control for Forest Service wells only and the Forest Service is responsible for the water quality drawn from those wells. National and regional groundwater policy directs forest well drilling and pumping not to adversely affect connected riparian habitat and/or water quantity and quality. The revised plan does not reiterate existing law, regulation, or policy. Arizona Department of Water Quality controls adjacent water withdrawal from current and new wells.

Concern Already Considered in Analysis

Issue: *The proposed revised plan may not adequately address the northern goshawk.*

- *By removing standards associated with northern goshawk nest areas, post-fledging areas, foraging areas, and goshawk prey species, the proposed revised plan may not adequately ensure the viability of this species.*

Rationale: The standards and guidelines related to northern goshawk in the 1987 plan as amended were analyzed as part of the 1987 plan (alternative A) and substantially incorporated into other alternatives. Consequently, this concern would not generate another alternative.

Chapter 2. Alternatives

Introduction

This chapter describes the proposed action and other alternatives that satisfy the purpose of and need for revision, addresses issues raised during scoping, and briefly discusses alternatives eliminated from detailed analysis. It includes a description and maps of each alternative considered (see appendix A for maps). This section also presents the alternatives in a comparison table format, sharply defining the differences between each alternative and providing a clear basis for choice among options by the decision maker and the public.

Process Used to Develop Alternatives

The alternatives considered in this document were developed by evaluating the ecological and social conditions and trends on the forest and identifying changes to the forest plan direction that would help improve forest conditions and trends, as documented in the "Economic and Social Sustainability Assessment" (USDA Forest Service 2008a); "Ecological Sustainability Report" (USDA Forest Service 2009a); "Analysis of the Management Situation" (USDA Forest Service 2010a); and the "Potential Wilderness Evaluation Report" (USDA Forest Service 2016e). The 1987 plan was evaluated by the interdisciplinary team and other forest staff to determine what management direction was still relevant and should be retained in the proposed revised plan, as well as what was outdated and in need of revision, which resulted in the documents listed above. Input from American Indian tribes was carefully considered and incorporated in the development of the proposed revised plan and alternatives. Additionally, public meetings and public feedback periods were scheduled throughout the plan revision process to invite input on draft documents related to forest plan revision and to identify significant issues for inclusion in the proposed revised plan and development of plan alternatives analyzed in this document. (Detailed descriptions of the alternatives are found in this chapter in the section "Alternatives Considered in Detail.")

Alternative B was developed iteratively in a collaborative manner to address the needs for change and public and internal comments. The needs for change were identified and documented in the "Analysis of the Management Situation," which was completed in May 2010 (USDA Forest Service 2010a). The needs for change are grouped under three broad revision topics: (1) recreation, (2) forest community interaction, and (3) maintenance and improvement of ecosystem health. See the Needs for Change section in chapter 1 for additional information.

In addition to addressing the needs for change, the initial draft version of the revised plan retained most of the direction from the 1987 plan, in particular, key direction from amendments for the Sedona-Oak Creek Ecosystem (Amendment 12) and the Flagstaff/Lake Mary Ecosystem Analysis (Amendment 17). When appropriate, this retained direction was elevated to have forestwide application. Additional information on the development of alternative B in included below in the Alternatives Considered in Detail section.

During 2010 to 2011, the Forest shared two initial draft versions of the revised plan for public and Forest employee review and feedback. Public responses to the initial draft versions indicated that there were concerns related to recreation, community/forest interaction, and ecosystem health. If it was possible to do so, concerns raised during public scoping were incorporated into the proposed revised plan that was analyzed in the DEIS, either by modifying existing language or by adding new

language. The following issues were those that have been incorporated into the proposed revised plan:

- Concerns tied to recreation:
  - Plan direction that steers managers away from single-use trails may increase user conflict in the Fort Valley-Mount Elden Management Area.
  - The proposed revised plan may not address the imbalance of available trails between Sedona and the rest of the Verde Valley.
- Concerns tied to use/management:
  - Smoke from prescribed fires may significantly affect nearby communities with respect to human health and impacts to local tourism.
- Concerns tied to wildlife or ecosystem impacts:
  - Old-growth forest components and large, pre-European settlement trees are underrepresented on the landscape and may not be adequately protected in the proposed revised plan.
  - Plan language relating to grazing management may not be sufficient to provide enough understory for ecosystem function as well as forage for native wildlife, particularly in times of drought.
  - Proposed revised plan direction may not adequately protect against degradation of water quality from allowed uses on the forest.
  - The proposed revised plan may not adequately limit impacts to watershed condition from high road densities and road stream crossings.

Alternative B addressed the needs for change and the issues related to recreation, use/management, and wildlife or ecosystem impacts listed above. The discussion on alternative B (modified) in the Alternatives Considered in Detail section describes the elements of the alternative that were developed to address the needs for change and these issues.

Not all of the concerns in the public responses were addressed in alternative B (modified). These concerns could not be incorporated into alternative B due to inherent conflicts in the expressed concern (e.g., not enough wilderness areas versus too many wilderness areas). These concerns were identified as “issues” and were used to develop alternatives to alternative B. A complete list of issues is found in chapter 1 in the “Issues” section. These issues were used to develop alternatives to alternative B. Some alternatives (C and D) were analyzed in detail, while other alternatives were considered, but eliminated from further study. These eliminated alternatives and their respective rationales for elimination are stated below.

Alternative C reflects management that emphasizes more primitive and natural settings with reduced human-related disturbances, such as from motorized use and nonrecreational shooting. It was developed to address public desires for more wilderness, additional protections for wildlife habitat and botanical and geological resources, and retention of the prescriptive management for old-growth vegetation found in the 1987 plan. Alternative C was developed to address the following concerns:

- Concerns tied to recreation:
  - Some recreation activities in the proposed revised plan, such as snowmobile use and recreational shooting, may cause noise and disturb other, different recreation activities and settings.
  - The proposed revised plan may not adequately meet the demand for wilderness areas and their associated primitive, undeveloped settings.
- Concerns tied to use/management:
  - In the proposed revised plan, grazing may negatively impact the values for which research natural areas were designated.
- Concerns tied to wildlife or ecosystem impacts:
  - The proposed revised plan may not fully address disturbance of wildlife species from motor vehicle traffic in areas on the forest.
  - The proposed revised plan may not adequately promote habitat connectivity, nor promote the identification or removal of potential barriers to wildlife movement.
  - Old-growth forest components are underrepresented on the landscape and were better provided for in the 1987 plan than in the proposed revised plan.

Alternative C addressed the recreation-related issues listed above by making several changes to the proposed revised plan. To improve the forest's ability to meet the demand for wilderness areas and their associated primitive, undeveloped settings, alternative C significantly increased the number of recommended wilderness areas. Alternative C also expanded the Cottonwood Basin Geological Area to highlight the outstanding botanical diversity of the area.

The wilderness areas that would be recommended under this alternative include all the potential wilderness areas that rated high for wilderness capability (i.e., high level of wilderness character), as well as areas that had medium capability but were raised by the public as deserving additional consideration as wilderness. Two potential wilderness areas that were rated to have medium capability, White Horse and Bismark, were not considered further because of management conflicts that would occur with the allowed mountain bike use on the Arizona National Scenic Trail and the Hart Prairie Fuels Reduction and Forest Health Restoration Project that fall within these potential wilderness areas. Plan language for the eight management areas that emphasize reduced human-related disturbance and the wildlife species emphasized in each of those management areas is listed in appendix F.

Additionally, recreation settings with less noise disturbance would be promoted through restrictions on snowmobile use and recreational (i.e., nonhunting) shooting in certain locations on the forest. Under alternative C, new suitability tables for recreation and transportation and recreational shooting and snowmobile use would replace the recreation and transportation suitability table in the proposed revised plan. The replacement tables are included in appendix F.

Alternative C addressed the use/management issue listed above by adjusting the proposed revised plan's direction on livestock grazing. To ensure research natural areas are adequately protected, alternative C includes a component that would allow livestock grazing to be restricted in certain circumstances.

Alternative C addressed the issues related to wildlife and ecosystem impacts by making several changes to the proposed revised plan. Alternative C also responds to the issues related to noise

disturbance and habitat connectivity for wildlife through the identification of eight management areas that emphasize reduced human-related disturbance. These management areas are designed to provide a low disturbance wildlife habitat for native wildlife species, allow for improved wildlife habitat (including habitat connectivity), and protect water quality and soil, vegetation, and water resources by limiting motor vehicle traffic. New plan language associated with these changes would be incorporated into the proposed revised plan through additional plan components and modifications to the components in the proposed revised plan. Plan language for the eight management areas that emphasize reduced human-related disturbance and the wildlife species emphasized in each of those management areas is listed in appendix F.

Alternative C considers the issue that suggests that old-growth forest components were better provided for under the 1987 plan. The 1987 plan standards and guidelines associated with old-growth forest components were evaluated. Some of those old-growth forest components were edited to make it harmonize with the rest of the draft plan and some of the current plan language was dropped because it was already covered by a component in the draft plan. For example, instead of allocating 20 percent at the ecosystem management area or an arbitrary spatial designation of 10,000-acre blocks, old-growth forest allocations would be managed at each mid-scale unit (assessed by 6th code watersheds). The resulting old-growth direction would be incorporated into the proposed revised plan through additional plan components and modifications to the components in the proposed revised plan. The additional and modified plan language for old-growth management is listed in appendix F.

Alternative D reflects management that emphasizes increased access across the forest and increased infrastructure development. It was developed to address public desires for no additional wilderness, the allowance of mechanized recreation (e.g., mountain biking) in botanical and geological areas, and the expansion of and/or increased access to energy corridors. Alternative D was developed to address the following concerns:

- Concerns tied to recreation:
    - The recommended wilderness areas in the proposed revised plan may negatively limit management and uses in these areas and increase restriction on public access.
    - The determination to make mechanized use unsuitable in botanical and geological areas may unduly restrict mechanized use from these areas.
- Concerns tied to use/management interaction:
    - The scenic integrity objectives established in the proposed revised plan may negatively impact the management and potential expansion of the power line between Sycamore Canyon Wilderness and Red Rock Secret Mountain Wilderness and the potential to use the Arizona Public Service Alternative Energy Corridor (along State Highway 87) as an alternate route for expanding capacity on the Western Area Power Administration line.

Alternative D addressed the recreation-related issues listed above by making several changes to the proposed revised plan. Under alternative D, no new wilderness areas would be recommended. Additionally, mechanized recreation would be suitable on designated trails in botanical and geological areas. A new recreation and transportation suitability table would replace the recreation and transportation suitability table in the proposed revised plan. The replacement table is included in appendix F.

Alternative D addresses the use/management issue by providing for expansion and/or increased access for future energy corridor needs, as well as modification of scenic integrity objectives along existing energy corridors for energy infrastructure. Specifically, this alternative would change the scenic integrity objectives associated with the power line between Sycamore Canyon Wilderness and Red Rock Secret Mountain Wilderness to a low scenic integrity objective rating instead of a moderate rating. In addition, alternative D would consider using the Arizona Public Service Alternative Energy Corridor (along State Highway 87) as an alternate route for expanding capacity on the Western Area Power Administration line, which currently crosses two wild and scenic rivers and a designated wilderness. This corridor would also need to identify a route going north, which would not require a plan amendment for scenic integrity objectives under this alternative (see appendix F).

The 1987 plan was retained as alternative A. It provides this analysis with a no action alternative and does not vary from the existing management direction situation. Generally, it serves as a baseline to which the effects of the proposed action and other alternatives can be compared. Alternative A does not address any of these needs for change as those needs are based on a review of the plan direction in alternative A.

After incorporating the public comments into alternative B, developing alternatives C and D to address other comments, and refining the plan components, the forest released a completed draft (the proposed revised plan) for formal public comment in December 2013. The forest received over 1,100 individual comments covering various topics, including: wilderness recommendations, proposed wildlife habitat management areas, motorized access, recreational shooting, management areas, climate change, species viability, municipal watershed and water supply, use of reclaimed water, management indicator species, and specific language within the plan components. The forest made several adjustments to alternatives B (proposed revised plan) and C in response to these comments (public comments and the agency's responses are found in appendix D of the FEIS), additional internal reviews, and formal consultation with the Fish and Wildlife Service (as required by section 7 (a)(2) of the Endangered Species Act). Additional information on these changes may be found in chapter 1 in the Summary of Changes from the Draft Environmental Impact Statement and Proposed Plan section.

Limited resources constrain the potential achievements of any plan alternative and, as such, are considered in the environmental consequences disclosed in this document. However, depending on the type of plan component, limitations in resources may have a variable effect: with regard to their overall desired conditions, alternatives B (modified), C, and D were written to be largely independent of the time or resources necessary for achievement; conversely, due to their specificity, plan objectives in each alternative were developed with consideration of the constraints in resources and timeframes in which they would be achieved.

Climate change was also considered during the development of alternatives B (modified), C, and D and follows the strategy identified in "Southwestern Region Climate Change Trends and forest Planning" (USDA Forest Service 2010c). Given the difficulty of providing specific management guidance relative to climate change, the nature of the alternatives to manage toward desired conditions regardless of current or changing conditions (such as climate change) is intended to allow management of the forest to adapt as necessary to continue moving toward ecological and social desired conditions.

Renewable Resources Planning Act Program

The 1982 Planning Rule provisions at 219.12(f)(6) require land management plans to respond to and incorporate the Renewable Resource Planning Act program objectives for each national forest as displayed in regional guides. There is no longer a regional guide for the Southwestern Region. This was withdrawn as required by the 2000 Planning Rule (36 CFR 219.35(e)). The last Renewable Resource Planning Act program was developed in 1995. In lieu of the Renewable Resource Planning Act program, the USDA Forest Service Strategic Plan Fiscal Year 2007–2012 (USDA Forest Service 2007) provides broad overarching national guidance for land management planning and national objectives for the Agency as required by the Government Performance Results Act. All of the alternatives in this EIS address these broad strategic objectives.

Alternatives Eliminated from Detailed Study

Federal agencies are required by the Council on Environmental Quality regulations to rigorously explore and objectively evaluate all reasonable alternatives and to briefly discuss the reasons for eliminating any alternatives that were not developed in detail (40 CFR 1502.14). Public comments received up until the release of this EIS include suggestions of alternative options for satisfying the purpose of and need for Agency action (the Agency's response to alternative options provided through public comments during the 90-day comment period are found in appendix D of the FEIS). The following alternatives were considered but dismissed from further evaluation in this EIS for the reasons summarized below.

- **Prohibition of prescribed fires as a management tool:** This alternative considered the management of vegetation on the Coconino NF solely by mechanical means and would have eliminated the use of prescribed fire with the goal of reducing smoke-related impacts to air quality in surrounding communities. This alternative, however, was not considered in detail because it is inconsistent with the management needs of the fire-adapted ecosystems on the national forest. All alternatives considered in detail include direction to meet State and Federal air quality standards and minimize smoke impacts to the public. The following provides a detailed explanation of why prescribed fires are essential on the Coconino NF:

  Why is fire necessary on the landscape?

  Fire is an essential disturbance agent in fire-adapted/dependent ecosystems (i.e., Ponderosa Pine, Mixed Conifer with Frequent Fire, Pinyon Juniper, Semidesert Grassland, and Interior Chaparral ecological response units (ERUs)). For these ecosystems the viability of growth, structure, function, and health of the forest is dependent on a fire regime. Many of the processes that initiate plant germination, maintain wildlife habitat, maintain water quality/quantity, etc., and require fire at frequent intervals (Moore et al. 1999). Mechanical removal of vegetation is effective in removing unsustainable densities and canopy cover of vegetation; however, it does not adequately reduce fuel loading or restore necessary ecosystem processes (Omni and Martinson 2002). In fact, mechanical treatment alone can increase available fuel and result in a more intense and faster spreading fire (Omni and Martinson 2002). If fire is removed from these systems, whether by policy, management decisions, etc., the resultant ecosystem is altered in a way that may jeopardize the overall sustainability and integrity of the system.

  In the case of many southwestern forests, fire exclusion by past management actions has led to a change in ecosystem attributes, structure, and function. The buildup of vegetation debris on the forest floor, in conjunction with higher vegetation densities and canopy cover, has resulted in an increase in fire intensity and severity, beyond the natural historical range of

variability. Such conditions could produce fires with rapid rates of spread, high fire intensity, and high fire severity at levels which managers cannot safely control (Moore et al. 1999).

- **Sixteen-inch diameter restriction on cutting trees:** Alternatives A, B, C, and D include desired conditions and guidelines that foster old-growth forest components and the retention of old trees, but do not include maximum diameter restrictions for tree harvest. Although the staff of the Coconino NF values large trees, the forest determined that applying this diameter restriction on cutting trees forestwide would limit future flexibility in management in terms of the narrowing range in conditions of forest structure and composition and would not help achieve forest desired conditions if applied unilaterally.

  Fire-adapted forest systems in the Southwest were historically driven by frequent fire burning through an herbaceous understory to maintain open, uneven-aged conditions in ponderosa pine and dry mixed conifer forests. On today's southwestern landscapes, restoration treatments are used to lower the overstory density and to reduce continuous cover that will allow growth of groups of younger trees sufficient to reestablish these open, uneven-aged conditions and prevent uncharacteristic fire regimes. Ultimately, the goals of restoration are to provide healthy habitat function for plants and animals, lower fire risk to surrounding communities, and provide for economic and social benefits. Results of a study conducted by the Southwestern Regional Office (USDA Forest Service 2011c) question both the effectiveness and the sustainability of restoration treatments under a strategy that imposes diameter cut limits.

  This analysis showed that within 3 decades, nearly all stands managed under a tree cutting size cap would be converted to an undesirable, functional even-aged condition. This level of landscape-scale homogeneity lacked biological diversity and indicated an unstable ecosystem subject to simultaneous large-scale disturbances, such as uncharacteristic fire.

  The literature discusses a difficulty inherent in the use of diameter caps; essentially diameter caps present a uniform solution to the myriad issues presented by ecosystems, and as such, result in tradeoffs (Abella et al. 2006). For example, studies of diameter cap use and efficacy reflected similar conclusions, stating that while some ecosystem components may benefit from the use of diameter caps (e.g., wildlife that may benefit from higher tree densities), other components may be harmed (e.g., understory vegetation) (Abella et al. 2007).

  Additionally, the results indicated that where diameter limits are imposed, the continued growth of residual trees following treatments would conflict with the intent of diameter limits and lead to a favoring of greater tree densities and dominance of shade-tolerant tree species, heavier fuel loads, increased homogeneity of structure, lower biodiversity, and higher frequencies of uncharacteristic crown fires.

  This alternative was eliminated from further consideration; however, decisions to focus on cutting trees of a given size range could still be made at the project level based on necessary actions to move existing conditions toward vegetative desired conditions.

- **Specific consideration of a motorcycle trials area:** Although consideration of a motorcycle trials area was included in a working draft of the revised plan that was shared with the public for feedback during the scoping period, it was decided that consideration of a motorcycle trials area was too specific a recreation use to include in the plan. It was determined that this and other similar specialized recreation uses would be more appropriately considered at site-specific levels.

- **Recommendation of a national scenic area designation for the Sedona-Oak Creek area (the area covered by Amendment 12 of the 1987 plan)**: In 2012, the Forest Service expressed support on a legislative effort to create a national scenic area designation for the Sedona-Oak Creek area. An alternative to recommend national scenic area designation for this area was eliminated from detailed consideration because the land adjustment plan direction that was central to the national scenic area legislative proposal has been carried into the proposed action and alternatives, and the values sought through such a designation have been incorporated.
- **Vegetation should be quantitatively assessed to ensure continued ecosystem function and sufficient forage for native ungulates and domestic livestock**: This alternative was not considered in detail because the desire to have functioning landscapes, including enough vegetation for ecosystem functioning and forage for native and domestic ungulates, is provided for by plan components for vegetation in the alternatives considered in detail and as part of the development of those plan components, vegetative forage was qualitatively analyzed for all species. It was determined by specialists that quantitative analysis as requested is not practical at the forest plan level because climate, site conditions, and native ungulate (such as pronghorn, mule deer, and white-tail deer) use of those sites can vary annually and on a longer term basis. Furthermore, Agency policy exists for evaluating the range conditions, drought, and determining permitted levels of livestock grazing on the forest and so would provide for adequate ecosystem function.
- **Prohibition or limitation on livestock grazing**: Alternatives to eliminate grazing or reduce stocking levels by 25 and 50 percent were not considered in detail. The Coconino NF contains lands that are potentially capable and suitable for livestock grazing (1,308,276 acres). Imposing a unilateral prohibition on livestock grazing will not meet the legal direction of the National Forest Management Act (NFMA) or Multiple-Use Sustained Yield Act (MUSYA), which direct that forests will be managed using multiple use, sustained yield principles. Agency policy exists for determining permitted levels of livestock grazing on the forest. Decisions on stocking levels (the number of livestock authorized to graze in an allotment) are made at the project level, not the programmatic level, based on the conditions that are present in the project area. Livestock grazing on the Coconino NF is managed to be consistent with NFMA and MUSYA. These laws do not require livestock grazing when/where ecological conditions are not appropriate. The forest plan is designed to manage for ecological desired conditions, as well as social and economic desired conditions (including uses such as livestock grazing, harvest of forest products, and recreation).
- **Specification of road densities:** This alternative considered specifying road density limits across the forest to limit the impacts of roads on wildlife and watershed conditions. Because road impacts to both wildlife and watersheds are more complex than simple road densities and may be equally affected by road design and location, consideration of specifying road densities was eliminated from further consideration in the action alternatives. While alternative A (1987 plan), however, does include standards and guidelines related to road densities, plan language to mitigate road impacts to wildlife and watersheds is only included in alternatives B, C, and D.
- **Designation of long-term research plots:** Long-term research plots are those established on the forest by external stakeholders in the early 1900s that remain in internal and/or external use. They are typically small plots located across the northern half of the forest and were intended to provide a sampling of the landscape-scale conditions north of the San Francisco Peaks. This alternative considered designating long-term research sites across the forest and would have limited other activities that would interfere with research purpose of the long-term

sites. This alternative was not considered in detail because such designation would be too site-specific for a programmatic forest plan. The special use permit that currently is issued for these sites does not provide exclusive use of the property and, therefore, allows forest management, recreation, and other activities to continue in its vicinity. Forest Service regulations (36 CFR 251.54 (e)(iv)) state that special uses, "will not create an exclusive or perpetual right of use or occupancy." As with all special uses, the restrictions on other forest activities are more appropriately considered on a case-by-case basis and managed by site-specific projects and proposals on the basis of safety, managing user conflict, and the merits of the proposed use.

- **No road construction**: Comments received on the proposed plan and DEIS recommend an alternative with no road construction. See Concern Statement #101 in appendix D of this FEIS for additional details on the comments and the forest's response.

  An alternative to forbid new road construction was considered to not be feasible. For example, new road construction may be required when access to a particular resource or private inholding is needed. New motorized trails may be needed to provide motorized recreation opportunities, including destinations and loops. Alternatives B (modified), C, and D address the impacts of roads and motorized trails on forest resources. Any new road or motorized trail construction would only be authorized following project-level environmental analysis and would be accomplished using best management practices to minimize resource impacts while providing for forest access needs.

Alternatives Considered in Detail

Four alternatives are analyzed in detail in this document: alternative A (1987 plan); alternative B (proposed revised plan); alternative C, which considers increases in the amount of wilderness and special areas, as well as increased opportunities for semiprimitive recreation; and alternative D, which considers fewer restrictions on human access, use, and infrastructure.

This chapter provides a general overview of each alternative and discusses the manner in which each alternative meets the needs for change topics and significant issues defined in collaboration with the public during the planning process.

Elements Common to All Alternatives

All four alternatives have a number of features in common. In particular, they:

- Comply with applicable laws, regulations, and policies;
- Conserve soil and water resources and do not allow significant or permanent impairment of the productivity of the land;
- Provide protections for riparian areas;
- Maintain air quality that meets or exceeds applicable Federal, State, and/or local standards or regulations;
- Provide for and maintain diversity of plant and animal communities to meet overall multiple-use objectives;
- Provide for species' viability across the planning area;
- Include measures for preventing the destruction or adverse modification of critical habitat for threatened and endangered species;

- Use a common list of management indicator species. The management indicator species were selected based on regional guidance and recommendations from forest, Federal, and State agency specialists. The following three management indicator species were used to compare and evaluate the alternatives: Mexican spotted owl, pronghorn , and the pygmy nuthatch;
- Protect heritage resources;
- Recognize the unique status of Native American tribes and their rights retained by trust and treaty with the United States, including consultation requirements;
- Provide sustained multiple uses, products, and services in an environmentally acceptable manner (including leasable and locatable minerals, timber, livestock forage, and recreation opportunities); and
- Retain existing designated areas (e.g., wilderness areas, wild and scenic rivers, special areas).

In addition, the following features are common to all alternatives.

Desired Conditions

Desired conditions (or goals) that apply to all of the Coconino NF include descriptions of desired outcomes as a result of Forest Service management. The desired conditions are described in detail in the proposed revised plan (alternative B (modified)), and are the same for alternatives C and D. While these desired conditions are used to analyze environmental consequences, alternative A provides its own set of stated goals and desired conditions.

Management Areas

Management area direction provides desired conditions, standards, and guidelines that apply to specific areas of the Coconino NF. Alternative A (the 1987 plan) identifies 38 management areas based on vegetation type. Alternatives B (modified) and D use a common set of 18 management areas based on scenery, use, and geographic areas. Alternative C uses many of the same management areas as alternatives B (modified) and D, but there are some differences. Alternative C does not organize plan direction on watersheds important for municipal water supplies into management areas for the C.C. Cragin watersheds, the Inner Basin, and the Lake Mary watersheds. Alternative C includes eight management areas that have an emphasis on reduced human-related disturbance.

Monitoring Strategy

Each alternative has a monitoring strategy. The monitoring strategy for Alternative A is included in the Monitoring Schedule in the 1987 plan. Alternatives B, C, and D include a common monitoring strategy, which is located in chapter 5 of the draft revised plan. Monitoring and evaluation provides the adaptive management strategy for determining the degree to which on-the-ground management is maintaining or making progress toward desired conditions.

Roadless Area Conservation Rule

All alternatives include management direction for inventoried roadless areas (IRAs) identified in the 2001 Roadless Area Conservation Rule. Alternative B (modified) includes direction that retains the undeveloped character of these areas. Comments received in the scoping process and between the draft and final EIS will help the Agency determine the scope of issues related to roadless area management and guide the analysis of environmental effects. Each alternative includes recreation opportunity spectrum, and alternatives B (modified), C, and D include suitability determinations, that retain the roadless character of these areas and is compatible with the Roadless Area Conservation Rule. All roadless areas were considered for their wilderness potential.

Wilderness

Each alternative contains wilderness areas, but only two alternatives recommend new wilderness areas or expansions of existing wilderness areas. For alternatives A and D, there are no recommended areas or acres in addition to the 10 existing designated wilderness areas that total 156,374 acres[4] (8.5 percent of the forest[5]). For alternative B (modified), 3 areas are recommended that encompass approximately 8,733 acres in addition to the existing wilderness acres, totaling 165,107 acres (9.0 percent of the forest). For alternative C, 13 areas are recommended that encompass approximately 91,757 acres[6] in addition to the existing wilderness acres, totaling 248,131 acres (13.5 percent of the forest).

Wildland-urban Interface

All alternatives provide direction for fuels reduction treatments and maintenance of vegetation for those areas of resident populations at imminent risk from wildfire, as well as human developments having special significance, such as critical communications sites, critical sites for water supply, high voltage transmission lines, and other structures that if destroyed by fire, would result in hardship to communities. These wildland-urban interface areas encompass not only the sites themselves, but also the continuous slopes and drainages both up and down slope and fuels that lead directly to the sites regardless of the distance involved.

Fire management strategies and other plan language, however, differ between alternative A and alternatives B, C, and D. Details of the features common to alternatives (as described above) can be found in the 1987 plan (as amended) or in the revised plan that accompanies this document.

Alternative A (1987 plan)

General Overview

The National Environmental Policy Act (NEPA) requires a "no action" alternative, an alternative that does not vary from the existing management direction situation. This no action alternative generally serves as a baseline to which the effects of the proposed action and other alternatives can be compared. In this document, the no action alternative is alternative A, or the 1987 plan, as amended. An electronic copy of alternative A (the 1987 plan) is provided in its entirety on the Coconino NF website.[7]

Alternative A:

- Established goals, objectives, standards, and guidelines (collectively, these are referred to as "plan components") to protect ecosystems and maintain or improve ecosystem function

[4] The Coconino, Kaibab, and Prescott National Forests share wilderness areas that total 442,502 acres. Within the Coconino National Forest administrative boundary, there are 10 designated wilderness areas, totaling 156,374 acres. Of these 10, the "Coconino National Forest Land and Resource Management Plan" provides direction for 8 designated wilderness areas, a total of 151,333 acres. The "Tonto National Forest Land and Resource Management Plan" provides direction for Mazatzal Wilderness, and the "Kaibab National Forest Land and Resource Management Plan" provides direction for Kendrick Mountain Wilderness.
[5] Percentages are based on the lands managed by the Coconino National Forest (1,842,965 acres).
[6] Alternative C recommends Hackberry Wilderness, the boundary of which is shared between the Coconino and Prescott National Forests. This number includes the entire recommended area, a total of 26,044 acres, of which 25,131 acres are on the Coconino National Forest and 905 acres are on the Prescott National Forest.
[7] http://www.fs.usda.gov/coconino/

based on the scientific understanding of ecosystem structure and function of approximately a decade or more ago;

- Includes specific guidance for Mexican spotted owl, northern goshawk, and other wildlife species;
- Identifies additional guidance for 38 management areas with associated management emphasis;
- Directs that the recreation opportunity spectrum system should be used to increase opportunities for a wide variety of developed and dispersed recreation experiences;
- Recognizes that education and interpretation are primary tools to encourage good stewardship by the public; and
- Encourages close partnerships with permittees, nonprofits, and other agencies to provide this service'

(Please see maps 1, 4, 25, 29, and 32 related to alternative A in appendix A.)

Alternative B (modified) – Proposed Revised Plan

General Overview

The proposed revised plan would provide strategic, program-level guidance for managing the forest and its natural resources over the next 10 to 15 years.

The proposed revised plan retains some of the direction from the 1987 plan, in particular, key direction from amendments for the Sedona-Oak Creek Ecosystem (Amendment 12) and the Flagstaff/Lake Mary Ecosystem Analysis (Amendment 17). It differs from the 1987 plan, however, in a number of fundamental ways that are aimed at allowing forest management to be adaptable over time and to be able to adjust to site-specific conditions. Therefore, the proposed revised plan:

- Places emphasis on long-term, strategic vision or desired conditions—both with respect to natural resources and human uses—that projects and related management activities must maintain or make movement toward;
- Clarifies distinctions between plan components, including standards and guidelines, and the type of guidance they provide. Allows increased flexibility to achieve the desired conditions over time by reducing the number of standards and guidelines, and stating the intent behind each guideline so that the intent of the guidelines can be followed even if not the exact direction provided by the guideline itself;
- Includes objectives that provide measurable, time-specific activities intended to make progress toward desired conditions;
- Creates 18 management areas within the forest;
- Does not repeat existing law, regulation, and policy; and
- Identifies management approaches that can be used to achieve desired conditions.

Recreation

To address the needs for change and public comments associated with recreation, alternative B (modified) would:

- Change from the 1987 plan's Visual Management System to the Scenery Management System as the tool to evaluate scenery and consequently update desired scenery integrity objectives;
- Update recreation settings throughout the plan via the recreation opportunity spectrum;
- Clarify that the relationship between outfitter and guide levels should be determined, in part, using encounter levels from the designated recreation opportunity spectrum class (e.g., rural, semiprimitive nonmotorized) for the area;
- Include a forestwide management approach for trails and trailheads to consider single use trails to accommodate varying user experiences where trail design features cannot mitigate user conflicts or provide for a sustainable recreation setting;
- Include a forestwide management approach for trails and trailheads to include input from county trails coordinators and local groups and citizens when conducting trail planning;
- Include desired conditions in the Volcanic Woodlands Management Area that highlights the scenic and cultural importance of the volcanic features in the area;
- Recommend three new wilderness areas: an extension to the existing Strawberry Crater Wilderness; Davey's Wilderness, which would serve as an extension to the existing Fossil Springs Wilderness; and Abineau, an extension of the Kachina Peaks Wilderness, totaling 8,733 acres;
- Designate both the Cottonwood Basin Geological and Botanical Areas as a combined special area, totaling 763 acres; and
- Determine that mechanized recreation is suitable on designated trails in botanical and geological areas.

Community–Forest Interaction

To address the needs for change and public comments associated with community-forest interaction, alternative B (modified) would:

- Clarify regulatory authorities relating to air quality;
- Include guidelines and management approaches for reducing smoke emissions;
- Encourage collaboration with many partners to achieve desired conditions;
- Acknowledge open space values, as well as potential future community expansion desires;
- Update guidance on energy and mineral development;
- Provide guidance related to forest products and consideration of culturally important forest products;
- Drop the reference that new communication sites are "rare;"
- Update plan guidance with criteria to provide flexibility to consider the requirements of new technology and broad public need;
- Incorporate plan components to support long-term research and providing guidance to help streamline the research permitting process;

- Add a guideline to research natural areas to guide grazing management in those areas: "Allotment management plans should have provisions to protect the uniqueness and/or ecological condition of the special areas;"
- Propose three new research natural areas.[8] West Clear Creek, Rocky Gulch, and an expansion of the existing San Francisco Peaks Research Natural Area; and
- Include a management approach in the Volcanic Woodlands Management Area to foster collaboration with the National Park Service on projects that could affect their lands and/or mission.

Maintenance and Improvement of Ecosystem Health

To address the needs for change and public comments associated with ecosystem health, alternative B (modified) would:

- Provide desired conditions and associated plan components for all of the vegetation types that exist on the forest, as well as soils, watersheds, and riparian systems;
- Provide desired conditions that generally reflect historical conditions where current conditions and legal obligations and authorities have not precluded attainment of these conditions;
- Provide desired conditions and other plan components that address or update guidance on invasive species, unique habitats, wildlife disease, and habitat connectivity;
- Allow fire to play a more natural role on the landscape and includes plan components that would address habitat and life history needs of forest analysis species;
- Consider effects of climate change and strategies to address those effects;
- Clarify the important ecological function of old growth forest components and their presence/distribution on the landscape;
- Include plan direction relating to the managing for older structural stages in the ponderosa pine vegetation type;
- Clarify that domestic livestock grazing maintains the desired composition, structure, and conditions of plant communities such that rangeland ecosystems are diverse, resilient, and functioning. Furthermore, manage forage, browse, and cover needs of wildlife and authorized livestock in balance with available forage;
- Include guidelines to reduce road impacts to wildlife and watershed condition, as well as encouraging collaboration with partners to improve habitat connectivity across the landscape; and
- Include desired conditions in the Volcanic Woodlands Management Area that cinder cones outside of the Cinder Hills Off-highway Vehicle Area maintain their integrity, form, and natural processes.

(Please see maps 2, 5, 8, 11, 14, 17, 20, 26, 29, 30, 31, and 33 related to alternative B (modified) in appendix A.)

[8] A West Clear Creek Research Natural Area, Rocky Gulch Research Natural Area, and expansion of the existing San Francisco Peaks Research Natural Area were proposed in the 1987 plan, but were never established. Although it proposes or re-proposes those research natural areas, this alternative identifies a different location for the proposed West Clear Creek Research Natural Area and a smaller area for the San Francisco Peaks Research Natural Area expansion. These adjustments were made to better meet the intent for their selection. Additional information can be found in the "Research Natural Areas Evaluation Report" (USDA Forest Service 2015d.

Alternative C

General Overview

Alternative C responds to suggestions from the public for more land to be managed in primitive and natural settings with reduced human-related disturbance for the benefit of recreation, and botanical and wildlife resources. Human-related disturbances are addressed in a number of ways. Additional wilderness areas would be recommended on the forest, as well as other special areas, to provide additional protection to botanical and wildlife resources. Alternative C also responds to ecological concerns related to presence or absence of old-growth composition and structure on the landscape.[9]

Like alternative B (modified), alternative C places an emphasis on long-term, strategic vision. It incorporates most of the plan components developed for alternative B (modified). Accordingly, alternative C's direction is similar to alternative B (modified) except for the following adjustments to address the public suggestions discussed above. The adjustments driven by alternative C include:

- Retention of some of the old growth direction from the 1987 plan by requiring:
  - Allocation of at least 20 percent of the naturally forested area by forest and woodland ERUs in any landscape by 6th code watershed;
  - Distribution of old growth in 100- to 300-acre stands; and
  - Use of the Minimum Criteria for the Structural Attributes Used to Determine Old Growth.
- Addition of a guideline restricting livestock grazing in research natural area;
- Designation of 8 management areas (East Clear Creek, Hospital Ridge, Jack's Canyon, Knoll Lake, Limestone Pasture, Pine Grove, Second Chance, and modification of alternative B (modified)'s Anderson Mesa Management Area) that emphasize reduced human related disturbance, totaling 335,371 acre; These management areas include plan components that:
  - Limit motorized dispersed camping to current levels;
  - Limit public motor vehicle access;
  - Limit large group recreation events and large commercial tours outside of developed sites; and
  - In the Anderson Mesa Management Area, limit public road density to an average of 1 mile or less of road per square mile.
- Recommendation for 13 new wilderness areas (Abineau, Barbershop, Black Mountain, Cedar Bench, Cimarron-Boulder, Davey's, Deadwood Draw, East Clear Creek, Hackberry, Railroad Draw, Tin Can, Strawberry Crater, and Walker Mountain), totaling 91,757 acres;
- Determination that mechanized use is not suitable in botanical and geological areas;
- Determination that recreational shooting (i.e., non-hunting shooting) is not suitable in botanical areas, geological areas, existing and recommended research natural areas, management areas that emphasize reduced human related disturbance (Anderson Mesa, Blue

[9] Initial analysis on this alternative revealed that some of the prescriptive elements associated with the wildlife habitat management areas (e.g., limitations on motorized use and prohibitions on grazing in riparian areas, overnight camping, and recreational fires) would be unnecessarily limiting to the forest's ability to provide sustained multiple uses, products, and services in an environmentally acceptable manner. Rather than remove the alternative from detailed consideration, the alternative was modified to remove or reduce the overreaching prescriptive elements. Information on the modifications to alternative C and rationale for those modifications are available in the project record.

Ridge, Hospital Ridge, Jack's Canyon, Knoll Lake, Limestone Pasture, Pine Grove, and Second Chance), Walnut Canyon Management Area, Sedona Neighborwoods Management Areas, Long Valley Management Area, and parts of the Flagstaff Neighborwoods Management Area; and

- Determination that snowmobile use is not suitable in the Walnut Canyon Management Area and areas with a semi-primitive non-motorized or primitive recreation opportunity spectrum objective.

Alternative C does not include the Inner Basin MA, C.C. Cragin Watersheds MA, and the Lake Mary Watersheds MA found in alternatives B (modified) and D.

Appendix F provides information on how the adjustments associated with alternative C would be incorporated with the other components included in alternative B (modified).

(Please see maps 3, 6, 9, 12, 15, 18, 21, 23, 24, 26, 29, 30, 31, and 34 related to alternative C in appendix A.)

Alternative D

General Overview

Alternative D responds to public suggestions for no additional wilderness areas and to allow mechanized recreation in botanical and geological areas. Alternative D also responds to issues regarding future energy corridor expansion needs.

Like alternative B (modified), alternative D places an emphasis on long-term, strategic vision. Like alternative C, alternative D incorporates most of the plan components developed for alternative B (modified). Accordingly, alternative D's direction is similar to alternative B (modified) except for the following adjustments to address the public suggestions discussed above. The adjustments driven by alternative D include:

- Setting the scenic integrity objectives associated with the power line between Sycamore Canyon Wilderness and Red Rock Secret Mountain Wilderness to a low rating (instead of a moderate rating);
- Setting the scenic integrity objectives associated with the energy corridor along State Highway 87 to a low rating (instead of a moderate or high rating);
- No recommendation for new wilderness areas; and
- Designation of only the Cottonwood Basin Geological Area as a special area, totaling 185 acres.

Appendix F provides information on how the adjustments associated with alternative D would be incorporated with the other components included in alternative B (modified).

(Please see maps 2, 7, 10, 13, 16, 19, 22, 28, 29, 30, 31, and 35 related to alternative D in appendix A.)

Forest Service's Preferred Alternative

Alternative B (modified) has been identified as the preferred alternative.

Alternatives Comparison

Table 1 presents quantitative and qualitative information comparing the potential for each alternative to address the topics identified in chapters 1 and 2. Table 2 summarizes the effects of each alternative. See corresponding sections of chapter 3 for more information.

Table 1. Comparison of alternatives[10]

No.	Topic and Indicator	Alternative	Comparison of Alternatives
1	Topic: Presence or absence of recreational shooting[a] opportunities. Indicator: Acres on which recreational shooting would be allowed and acres which would be restricted.	A	Total acres: Recreational shooting opportunities would be allowed on about 1,626,921 acres. Recreational shooting opportunities would be restricted on about 216,037 acres by law, regulation, and/or policy. Total percentage of forest: 88 percent allowed, 12 percent restricted. There are no suitability determinations for recreational shooting in alternative A.
		B (modified)	Same as alternative A
		C	Total acres: Recreational shooting opportunities would be allowed on about 1,134,333 acres. Recreational shooting opportunities would be restricted and/or not suitable on about 708,632 acres. This includes acres already subject to shooting restrictions under law, regulation and/or policy plus 492,595 additional acres that would not be suitable for this activity. Total percentage of forest: 62 percent allowed, 38 percent restricted and/or not suitable The following areas would not be suitable for recreational shooting: Existing and recommended research natural areas, botanical and geological areas, and the following management areas: Anderson Mesa, Blue Ridge, Hospital Ridge, Jack's Canyon, Knoll Lake, Limestone Pasture, Pine Grove, Second Chance, Walnut Canyon, Sedona Neighborwoods, Long Valley, and part of the Flagstaff Neighborwoods MA (to be determined through project level decisions and analysis).
		D	Same as alternative A
2	Topic: Presence or absence of snowmobile use opportunities. Indicator: Acres on which snowmobiling would be allowed and acres on which it would be prohibited or restricted to use only on designated trails.	A	Total acres: Snowmobile opportunities would be allowed on about 1,132,841 acres, subject to seasonal closures on about 49,349 acres, prohibited on about 565,010 acres, and restricted (only on designated trails) on 89,841 acres. There are about 5,924 acres of Forest Service land that is Experimental Forest (like G.A. Pearson and Long Valley) that are not included in these acres. Total percentage of forest: about 64 percent allowed (including areas with seasonal closures), 31 percent prohibited, and 5 percent restricted. There are no suitability determinations for snowmobile use in alternative A.
		B (modified)	Same as alternative A. Snowmobile opportunities would not be prohibited or restricted in recommended wilderness areas unless those areas are either congressionally designated or closed by a site-specific, project-level decision.

[10] Values given are approximate and based on computer mapping and other calculations. These values are subject to changes based on field verification and may differ from actual project layout and implementation.

No.	Topic and Indicator	Alternative	Comparison of Alternatives
2 (cont.)		C	Total acres: Snowmobile opportunities would be suitable and allowed on about 1,016,161 acres, subject to seasonal closures on about 48,896 acres, and restricted on 71,736 acres. Snowmobile opportunities would be not be suitable and/or prohibited on about 565,010 acres. About 135,238 acres that would be allowed, subject to seasonal closure, or restricted under alternative A would be not suitable for snowmobile opportunities under alternative C. There are about 5,924 acres of Forest Service land that is Experimental Forest (like G.A. Pearson and Long Valley) that are not included in these acres. Total percentage of forest: 58 percent suitable and allowed (including areas with seasonal closures), 4 percent suitable and restricted, 38 percent not suitable and/or prohibited. The following areas would not be suitable for snowmobile use: Walnut Canyon Management Area and areas classified as Semi-primitive Non-motorized or Primitive ROS (which includes all or portions of established or proposed research natural areas, botanical and geological areas, eligible or suitable wild and scenic rivers, and the following management areas: Anderson Mesa, Blue Ridge, Hospital Ridge, Jack's Canyon, Knoll Lake, Limestone Pasture, Pine Grove, Second Chance, Sedona Neighborwoods, Flagstaff Neighborwoods and Long Valley).
		D	Same as alternative A
3	Topic: Opportunities for experiences in primitive, wilderness, and undeveloped settings. Indicator: acres of by Recreation Opportunity Spectrum (Semi-primitive non-motorized and Primitive) and Wilderness Opportunity Spectrum classes	A	276,580 acres or 14 percent of the forest. Six percent of the acres are Semi-primitive Non-Motorized and 8 percent are Primitive. All wilderness acres are classified as Primitive. Alternative A has the fewest opportunities for these types of experiences.
		B (modified)	372,021 acres or 19 percent of the forest. Ten percent of the acres are Semi-primitive Non-Motorized, 1 percent are Primitive, and 8 percent are classified in the Wilderness Opportunity Spectrum. Alternative B (modified) has 95,441 more acres than alternative A and 25,985 fewer acres than alternative C. The key differences between alternative B (modified) and alternative C is that alternative B has 82,151 fewer acres of Primitive and 56,166 more acres of Semi-primitive non-motorized.
		C	398,006 acres or 20 percent of the forest. Seven percent of the acres are Semi-primitive Non-Motorized, 5 percent are Primitive, and 8 percent are classified in the Wilderness Opportunity Spectrum. The key differences between alternative C and alternative B (modified) is that alternative C has 82,151 more acres of Primitive and 56,166 fewer acres of Semi-primitive non-motorized.
		D	Same as alternative B (modified)

No.	Topic and Indicator	Alternative	Comparison of Alternatives
4	Topic: Potential constraints to management activities from designated and recommended wilderness areas. Indicator: Potential to constrain management activities by acres of designated and recommended wilderness	A	Motorized and mechanized use is not allowed in designated wilderness therefore treatments using motorized or mechanized equipment do not occur. Treatments may not be feasible or needed in all wilderness depending on vegetation type and ruggedness. In addition, plan language constrains the use of wildfires managed to meet resource objectives in wilderness. Wildfires in designated wilderness could have a greater risk of resulting in uncharacteristic fire effects, having higher fire severity and decreased likelihood of restoring historic fire regime and vegetation structure. There are 151,333 acres of designated wilderness and no acres of recommended wilderness. This is approximately 8.2 percent of the forest.
		B (modified)	The acreage and effects of designated wilderness is the same as alternative A. Alternative B (modified) removes the language in alternative A that constrains the use of wildfires managed to meet resource objectives thus there are more opportunities to treat ERUs with fire compared to alternative A. Although plan language constrains motorized use in recommended wilderness, which may be important for pre-treatment and safety in some situations, the overall affected area is limited and represents a small fraction of each ERU. There are 8,733 acres in three recommended wilderness areas. There are about 160,066 acres total of designated plus recommended wilderness or about 8.6 percent of the forest.
		C	The acreage and effects of designated wilderness is the same as alternative A. The effects of recommended wilderness are similar to alternative B (modified) except there are 91,757 acres of recommended wilderness. This is 83,024 acres more than alternative B (modified). There are fewer opportunities to use prescribed fire and wildfires for resource objectives than under alternative B (modified). This is a small fraction of most ERUs except for Semi-desert Grassland, Pinyon Juniper Evergreen Shrub and Pinyon Juniper Woodland in which between 13 to 19 percent of these individual ERUs are affected.
		D	Same as alternative A except like alternatives B (modified) and C, alternative D would not have the plan language that constrains the use of wildfire managed for resource objectives. There would be more opportunities to manage prescribed fires and wildfires to meet resource objectives than any other alternative.
5	Topic: Opportunities for mechanized use in existing and proposed botanical areas and geological areas. Indicator: Suitability for mechanized use in botanical and geological areas.	A	There are about 3.8 miles of designated trails within the 2,608 acres of botanical and geological areas in alternative A. Alternative A is silent on allowing mechanized use on designated trails within special areas and instead has language to manage botanical and geological areas to maintain existing conditions and natural processes. Carrying capacity in these areas would be assessed and visitors would be limited to meet this carrying capacity. Consequently, mechanized use would be allowed in botanical and geological areas as long as the use does not conflict with the purpose of the area.
		B (modified)	There are about 3.8 miles of trails in the 3,371 acres of Botanical and Geological Areas in alternative B (modified). Mechanized use would not be suitable in botanical or geological areas except mechanized travel would be suitable on routes designated for mechanized travel.

No.	Topic and Indicator	Alternative	Comparison of Alternatives
5 (cont.)		C	Alternative C is the same as alternative B (modified) except mechanized use would not be suitable in botanical and geological areas including designated trails. Existing mechanized use in botanical and geological areas would be eliminated. For example, about 2.6 miles in the Verde Valley Botanical Area would be closed to mountain bikes, including the Lime Kiln Trail.
		D	Alternative D has the same miles of trails and the same effects as alternative B (modified).
6	Topic: User conflict on trails in the Mount Elden MA. Indicator: Plan language that addresses user conflict on trails.	A	Alternative A has little language that addresses user conflicts on trails. However, there is language to restrict horse and packstock use on certain trails, language that emphasizes non-motorized use in some areas, and language that does not promote additional outfitter guide or group activities in the Mt. Elden/Dry Lake Hills trail system.
		B (modified), C, and D	Alternative B (modified) addresses user conflict forestwide. Plan language promotes the design, construction, and management of trails, recreation areas (such as winter recreation sites), and developed recreation sites to consider user experiences and to minimize user conflicts. In a management approach, this alternative reminds managers that single use trail may be considered where trail design cannot mitigate user conflicts. Like alternative B (modified), this alternative also restricts horse and packstock use on certain trails and emphasizes non-motorized use in some areas. Alternatives C and D are the same as alternative B (modified).
7	Topic: Trail opportunities are emphasized more in the Sedona and Oak Creek areas than the Verde Valley area. Indicator: Plan language that addresses trail opportunities in these areas	A	Alternative A has numerous plan components addressing recreation demand and opportunities in the Sedona and Oak Creek Areas. The few plan components for the Verde Valley Management Area focus mainly on specific areas such as lower Oak Creek, certain segments of West Clear Creek and Wet Beaver Creek, and the upper Verde River outside the wild and scenic river section. Alternative A better addresses the recreation demand in the Sedona and Flagstaff areas compared to other communities.
		B (modified), C, and D	Alternative B (modified) also addresses recreation demand and opportunities in the Sedona and Oak Creek areas but better addresses the recreation demand in the Verde Valley by updating and expanding plan direction and recognizing the need for a more diverse range of recreation opportunities for the Verde Valley Management Area as a whole. Alternatives C and D have the same language as alternative B (modified).

No.	Topic and Indicator	Alternative	Comparison of Alternatives
8	Topic: Potential for smoke concentration and duration from prescribed fires and wildfires to nearby communities. Indicator: Expected smoke impacts and mitigation to nearby communities from prescribed fire and wildfire management on the forest.	Common to all alternatives	There are no differences in the effects of plan alternatives on smoke from wildfires managed for resource objectives in the short term because wildfires are natural events and not directly regulated by ADEQ or EPA. However, fire managers manage smoke production on prescribed fires and wildfires managed for resource objectives with emission reduction techniques such as burning when atmospheric conditions are favorable and not burning when ventilation is poor. Emission reduction techniques are typically not used on wildfires NOT managed for resource objectives because fire managers focus on protecting values-at-risk like safety, life, and property. These techniques are used in all alternatives because the forest and ADEQ are actively involved in smoke issues even though alternative A is silent on these techniques. Alternatives B (modified), C, and D specifically point to the use of these techniques. Prescribed fires are regulated by the state for visibility and air pollutants at the airshed level. The intensity and duration of impacts to localized areas can be variable depending on the amount and type of fuels, acres burned, location, and duration of burn. The amounts of carbon monoxide and particulate matter produced from fires are similar among alternatives in the short term because of regulations and use of emission reduction techniques. Long term effects vary by alternative.
		A	In the short term, alternative A would have less impact to smoke than the other alternatives because plan language constrains the use of wildfires managed for resource objectives in designated wilderness areas, wildland-urban interface, and unroaded recreation settings. There could be fewer days with smoke impacts and fewer burned acres in the short-term compared to the other alternatives. Long-term impacts from fire treatments could be greater than other alternatives because untreated areas could lead to more uncharacteristic fires which produce more smoke in a short time period and these greater amounts may exceed air quality thresholds at the airshed scale.
		B (modified)	Alternative B (modified) potentially would have slightly more days with smoke impacts on nearby communities in the short term (compared to alternative A) because it allows the use of wildfire managed for resource objectives in wildland-urban interface and removes the constraints for using wildfire in wilderness. Long term smoke impacts from fire treatments would be lower than alternative A due to the increased level of treatment in the short term. The increased treatment would lead to fewer uncharacteristic fires, which produce more smoke that can exceed air quality thresholds. Accordingly, smoke under alternative B (modified) would be less likely to exceed quality thresholds than under alternative A. The concentration and duration of impacts to nearby communities will depend on the location and size of the burns.
		C	The effects for alternative C are the same as for alternative B (modified) even though alternative C has more acres of recommended wilderness and more acres managed for unroaded recreation setting. This is because even if these areas are untreated, it is assumed the forest will burn the same number of acres as alternative B (modified). Only the location from which the smoke would originate would change.

No.	Topic and Indicator	Alternative	Comparison of Alternatives
8 (cont.)		D	The effects for alternative D are the same as for alternative B (modified) with the exception of effects tied to recommended wilderness. The effects of not recommending any new wilderness areas are the same as alternative A.
9	Topic: Reduction of risk of uncharacteristic fire to nearby communities Indicator: Acres of treatment that reduces the risk of uncharacteristic fire to nearby communities.	Common to all	All alternatives would lower the risk of uncharacteristic fire through mechanical treatments and prescribed burning primarily in accessible areas within ponderosa pine vegetation. All alternatives are expected to meet the forest's legal obligations for air quality. There would be no difference in how alternatives affect air quality in terms of protecting human health since National Ambient Air Quality Standards are set at levels that are necessary to meet that objective at the airshed level.
		A	In contrast to other alternatives, alternative A prohibits the use of wildfires managed for resource objectives in the wildland-urban interface, Oak Creek Canyon, and has language that constrains the use of fire in wilderness. Consequently, some communities may be less protected from uncharacteristic fire than others however the opportunity to use fire at all and the amount of threat reduction depends on treatment frequency, location of wildfire relative to the community or infrastructure, and size and effectiveness of treatment as well topography, fuel type, and vegetation which vary widely across the forest. This alternative does not recommend new wilderness areas.
		B (modified)	Alternative B (modified) would reduce the risk of uncharacteristic fire to communities more than alternative A because there would be more opportunities for managing wildfires for resource objectives in wildland-urban interface, in wilderness, and Oak Creek Canyon paving the way for more frequent fire treatments. Depending on site-specific circumstances, the three recommended wilderness areas could make managing wildfires for resource objectives or mechanical treatments more complex and less likely even though restoration of the natural fire regime is encouraged in wilderness.
		C	Alternative C has the same effects as alternative B (modified) except it includes more recommended wilderness. The proximity of recommended wilderness to wildland-urban interface and the constraints associated with operating within and around wilderness can reduce the likelihood of managing wildfires for resource objectives within the wildland-urban interface. Generally, threats to communities in some locations would be slightly higher due to the higher amount of recommended wilderness.
		D	Alternative D has the same effects as alternative B (modified) except there are no recommended wilderness areas. Consequently, this alternative would provide the most opportunities for fire and vegetation treatments and as such, would result in the least threat of uncharacteristic fire to communities.

No.	Topic and Indicator	Alternative	Comparison of Alternatives
10	Topic: Potential livestock grazing impacts to research natural areas (RNAs). Indicator: Expected livestock grazing impacts within RNAs.	A	Few grazing impacts are anticipated. Alternative A assigns no grazing capacity to RNAs and has language so allotment management plans would have provisions to protect the uniqueness and/or ecological condition of these areas. In addition, three out of four existing RNAs are closed to grazing: Oak Creek, San Francisco Peaks, and Casner Canyon. The GA Pearson RNA is within the forest boundary but because it is experimental forest, it is outside of Coconino NF administration. The proposed, West Clear Creek, and San Francisco Peaks expansion RNAs are closed to grazing. Only the proposed Rocky Gulch RNA is open to grazing.
		B (modified)	Alternative B (modified) is similar Alternative A in terms of what is open or closed to grazing. It is also similar to alternative A in that a guideline would direct allotment management plans to have provisions to protect the uniqueness of the area. Alternative B (modified) is different than alternative A because desired conditions are provided for the existing and proposed Coconino administered RNAs. This explicit language provides direction that would retain and protect the specific ecologic feature(s) for which the RNA was designated. The proposed West Clear Creek RNA in alternative B (modified) is in a different location than alternative A, so the RNA has less recreational use. The San Francisco Peaks RNA expansion has fewer acres than in alternative A.
		C	Alternative C would restrict livestock grazing unless it supports or would not affect the research purpose of the RNA.
		D	Alternative D has the same effects as alternative B (modified).
11	Topic: Potential motor vehicle traffic impacts to wildlife.	All alternatives	All alternatives would reduce motor vehicle disturbance to wildlife through about 151,333 acres of designated wilderness, about 200-800 miles of decommissioned roads as identified on the motor vehicle use map, about 47,000 acres of seasonal closures, through seasonal timing restrictions for certain species, by providing large tracts of unroaded landscapes in Deadman Wash, by managing inventoried roadless areas, by protecting sensitive biological resources around Walnut Canyon National Monument, and by protecting caves and adjacent areas from unnatural disturbances.
	Indicator A: Percentage of acres in semi-primitive non-motorized and more primitive ROS classes, acres of recommended wilderness and plan language that addresses motor vehicle traffic impacts to wildlife.	A	Generally, alternative A has the highest disturbance from motorized vehicles, followed by B (modified), D, and C. Alternative A would have the lowest percentage in the semiprimitive nonmotorized and more primitive ROS classes of all the alternatives (14 percent) and would have no recommended wilderness Plan language would manage road densities to reduce disturbance to northern goshawk nest areas, Alternative A lacks timing restrictions for golden eagles which are protected under the Eagle Act.

No.	Topic and Indicator	Alternative	Comparison of Alternatives
11 (cont.)		B (modified)	Alternative B (modified) would have the second lowest disturbance from motorized vehicles, followed by alternatives D, then A. It would have the second highest percentage in the semi-primitive non-motorized and more primitive ROS classes compared to the other alternatives (20 percent) and would have 8,733 acres of recommended wilderness (more than alternatives A and D and less than alternative C). Plan language is lacking to manage road densities to reduce disturbance to northern goshawk nest areas or other species because road management has since been incorporated into the 2011 Travel Management Rule decision. In contrast to alternative A, alternative B (modified) provides timing restrictions for golden eagles which are protected under the Eagle Act (in addition to other species), provides a disturbance buffer around raptor nests to promote survival or successful reproduction forestwide rather than in just a few management areas.
		C	Alternative C would have the lowest motor vehicle traffic and disturbance compared to the other alternatives. It would have the highest percentage in the semi-primitive non-motorized and more primitive ROS classes compared to the other alternatives (21 percent) and would have about 91,757 acres of recommended wilderness (more than any other alternative). Unique to alternative C, eight management areas (349,884 acres) would have reduced public access, no net increase in the area of motorized dispersed camping corridors designated within these management areas, and large group recreation events and large commercial tours would not be permitted except in developed sites, except for research. In addition, the combination of recommended and designated wilderness in the southern portion of the forest would create a largely contiguous area of reduced disturbance and more primitive surroundings (about 114,003 acres). This does not occur in the other alternatives.
		D	Alternative D would have the third highest percentage in the semi-primitive non-motorized and more primitive ROS classes compared to the other alternatives (19 percent) and would have no recommended wilderness. Plan language is the same as alternative B (modified).
12	Topic: Representation and protection of old-growth forest components on the landscape Indicator: Environmental consequences of plan language that retains or protects old-growth structure/large trees.	All alternatives	In ponderosa pine, all alternatives would move toward desired conditions of medium to very large trees in open mostly uneven-aged conditions at a similar rate. This trend would reduce the risk of uncharacteristic fire or insect and disease outbreaks which could threaten old growth and the associated components. This trend would also mitigate nutrient and water stress so trees could be more vigorous, grow faster, and be more resilient to changing climate. In some portions of the forest, there would also be more closed conditions in larger patches such as on north facing slopes or in cooler moister microclimates or in areas managed for species that require those conditions. Pinyon juniper with grass ERU would move away from desired conditions because the anticipated treatment level in all alternatives is insufficient to offset regeneration and closing canopies in the long term.

No.	Topic and Indicator	Alternative	Comparison of Alternatives
12 (cont.)		A	Plan components in some portions of alternative A are outdated. Alternative A would apply outdated science to forest and woodland types and outdated methods to allocating old growth components. Examples include allocating snags and a minimum of 20 percent old growth by 10,000 acre blocks, allocating old growth in ponderosa pine and mixed conifer with frequent fire in 100- to 300-acre blocks, and having desired conditions that do not describe the structure that would result from the natural fire regime in frequent fire forests. Alternative A duplicates language from the original Mexican spotted owl recovery plan (e.g., in Mexican spotted owl restricted habitat, plan components would save all trees greater than 24 inches d.b.h.). The recovery plan was revised in 2012 and the term 'restricted' no longer applies. Alternative A prescribes that snags and downed logs necessary to meet wildlife objectives are fire lined for protection and monitored during burning. Old growth and snags in pinyon juniper would generally be provided on slopes greater than 15 percent rather than being distributed throughout the landscape. Under alternative A, mixed conifer with frequent fire would have a slower rate of improvement than the other alternatives.
		B (modified)	Plan language in alternative B (modified) would improve resistance to uncharacteristic disturbances (fire, insect and disease) and resiliency to a changing climate more than alternative A. Plan components for old growth retention and protection are updated in alternative B (modified) and apply more current science. Desired conditions for vegetation types more accurately reflect composition and structure that would result from natural fire regimes including for southwestern fire-adapted ecosystems. Plan components do not prescribe old growth allocation by 10,000 acre blocks (which are no longer used) or by 100- to 300-acre stand sizes (patch size should vary by fire regime). Rather than prescribing 20 percent old growth, an appendix describes the proportion of seral stages (including old growth) that would apply at the landscape scale for all vegetation types. Rather than specify specific techniques, alternative B (modified) allows a variety of methods to protect or maintain snags and downed logs to maintain or move toward desired conditions. Alternative B (modified) has guidelines to apply habitat management objectives and species protection measures from approved recovery plans instead of duplicating or using outdated recovery plan language. In contrast to alternative A, alternative B (modified) has a large tree strategy designed to develop and manage for pre-settlement trees in ponderosa pine. Unlike alternative A, old growth and snags in pinyon juniper would occur throughout the landscape rather than mainly on slopes greater than 15 percent. Under alternative B (modified), mixed conifer with frequent fire would have a more rapid rate of improvement under the high treatment objective compared to both alternative A and to the low treatment objective,

No.	Topic and Indicator	Alternative	Comparison of Alternatives
12 (cont.)		C	Alternative C would have similar effects as alternative A in the areas where at least 20 percent of each forest or woodland ERU was allocated to old growth in 100-300 acre stand sizes. This pattern and structure would not meet the desired conditions for southwestern frequent fire forests and these blocks would be at a greater risk of loss to disease and uncharacteristic wildfire because they would generally be composed of similar sized trees and would have more closed continuous canopies. In these areas, understory vegetation and shade intolerant species such as Gambel oak and aspen would also be suppressed due to limited sunlight. Old growth would be allocated by 6th code watershed rather than 10,000 acre blocks. Alternative C would have similar effects as alternative B (modified) in the areas outside of allocated old growth.
		D	Same as alternative B (modified)
13	Topic: Promotion of habitat connectivity and identification/ removal of potential barriers to wildlife movement. Indicator: Environmental consequences of alternative' language on habitat connectivity and wildlife movement	All Alternatives	All alternatives identify known corridors and support the retention of unfragmented areas such as in Deadman Wash. All alternatives promote fence designs that minimize obstructions to most animal movements and depending on fence location, the permeability of wildland blocks and movement corridors would be maintained or improved where ever they occur. Steeper slope habitats, designated wilderness, and rugged or hard to access terrain have maintained connectivity due to lack of management. Barriers to movement or mortality hazards like roads would be reduced through expected work associated with the 4-FRI project that would naturalize or decommission 200 to 800 miles of unauthorized roads and system roads. These are not new roads but are identified on the Motor Vehicle User Map. Roads fragment habitat by breaking large areas into small isolated patches supporting fewer individuals, and these small populations can lose genetic diversity and can be at risk of local extinction.
		A	Alternative A plan language is largely tactical (fences) and is applicable only in certain management areas. The Flagstaff/Lake Mary Ecosystem Analysis (FLEA) Area Amendment and Sedona Amendment come closest to describing the function and intent of connected habitats.

No.	Topic and Indicator	Alternative	Comparison of Alternatives
13 (cont.)		B (modified)	Alternative B (modified) substantially improves habitat connectivity language in the forest plan compared to alternative A by addressing interconnected terrestrial, riparian, and aquatic habitats forest wide. Plan language would promote access to new habitats, perpetuation of genetic diversity, species movements, dispersal, and migration, and it would maintain or improve habitat permeability, and mitigate effects to linkages. It facilitates safe passage for aquatic organisms on bridges, culverts, stream crossings and diversion structures and makes allowances for movement barriers where necessary to protect native aquatic species from non-native aquatic species. Other components that would enhance movement and connectivity include: New and reconstructed utility infrastructure would be located and designed to minimize adverse wildlife impacts and vegetation would be retained in rights-of-ways to allow for wildlife movement corridors if vegetation does not interfere with meeting vegetation clearance requirements. Alternative energy developments would be designed to minimize or avoid impact to other uses and resources, in particular wildlife. In addition, management approaches would encourage working with other agencies and groups to identify linkages and barriers to wildlife movements, mitigation during project design, the establishment and removal of fish barriers, and improvement of wildlife movements across interstate highways. Alternative B (modified) has three recommended wilderness that would be additions to designated wilderness thus expanding wildland block or corridor areas.
		C	Alternative C would substantially improve habitat connectivity language in the forest plan compared to the other alternatives. Alternative C is similar to alternative B (modified) except for the following. Alternative C has similar effects for recommended wilderness as alternative B (modified) except instead of 8,733 acres of recommended wilderness, there are 91,757 acres of recommended wilderness (905 of these acres are on the Prescott National Forest). The spatial arrangement of nine of these would result in mostly contiguous designated or recommended wilderness from the Wet Beaver Creek Wilderness south to the Mazatzal Wilderness. Unlike alternatives A and B (modified), alternative C would establish seven management areas (and modify the Anderson Mesa management area) (335,371 acres) to more explicitly emphasize corridors and connectivity. Impacts to wildlife and associated habitats would be limited by reducing public motor vehicle access, limiting large group activities and large commercial tours (except for research), and maintaining the current area of motorized dispersed camping corridors. The permeability of the associated wildland blocks and linkages would be maintained or improved by reducing disturbance. The recreation and transportation suitability determinations for alternative C would also maintain permeability of wildland blocks or core areas and reduce the impacts of barriers more than the other alternatives because new motorized areas and new motorized trails would be not suitable in these specific management areas. Note that suitability determinations are recommendations not decisions and are subject to site-specific NEPA analysis.
		D	Alternative D has the same impacts as alternative B (modified) except there are no recommended wilderness.

No.	Topic and Indicator	Alternative	Comparison of Alternatives
14	Topic: Adequate forage for ecosystem function, particularly in times of drought, as well as for native wildlife. Indicator: Expected effects of proposed revised plan or alternatives' guidance on grazing management on native mammals and ecosystem function.	Common to All	NEPA assessments, allotment management plans, monitoring, and annual operating instructions would continue under all four alternatives. If it is determined that the desired conditions are not being achieved on an allotment, grazing management practices and/or the current levels of the grazing use would be modified.
		A	Although much of the language in alternative A is outdated, alternative A accounts for having adequate forage for ecosystem function and native wildlife by having provisions to balance permitted livestock use and capacities by increasing or decreasing numbers of livestock, by changing the management intensity levels, and by initiating changes in livestock class, season of use, and rotation patterns. It also has language to make additional forage for big game populations where it is limiting, especially in winter range. Alternative A lacks explicit forestwide language that references ecosystem function however other forestwide language would maintain or enhance soil productivity and watershed condition where needed, which would enhance ecosystem function. Although drought is not explicitly mentioned, the above language provides sufficient flexibility to adjust livestock use and numbers to account for insufficient forage for grazing or insufficient understory vegetation for ecosystem function during droughts or emergency situations.
		Alternative B (modified), C, and D	Updated language in alternative B (modified) would provide for properly functioning ecosystems (within their type and capability), that provide habitat for native species and that are resilient to natural disturbances (e.g., flooding, fire, and periodic drought) and climate change. Ecosystem processes and contributions (e.g., nutrient cycling, water infiltration, and wildlife habitat) would be sustained. In addition, alternative B (modified) recognizes drought as a natural disturbance. Plan language for soil has been updated to include additional language for soil productivity and function and now includes language specific to vegetative ground cover and its relationship with ecosystem functions such as hydrologic function, soil stability and nutrient cycling. In addition, a guideline in livestock grazing promotes grazing and browsing use by authorized livestock and wildlife in balance with available forage production. Alternatives C and D have the same language and effects as alternative B (modified). As with alternative A, the above plan language provides sufficient flexibility to adjust livestock use and numbers to changing capacity on the ground. In the case of extended drought or other emergency, additional measures might be employed above and beyond those in the forest plan.
15	Topic: Protection against degradation of water quality from management activities and permitted uses on the forest.	Common to All	All alternatives have language to meet Arizona water quality standards and to implement best management practices for ground-disturbing activities to reduce sediment and improve watershed conditions.

No.	Topic and Indicator	Alternative	Comparison of Alternatives
15 (cont.)	Indicator: Plan language that would protect water quality	A	Alternative A would not move water quality to desired conditions as quickly as the other alternatives. This is because of lack of direction to move watersheds to proper functioning condition, lack of specific guidance to implement ADEQ recommendations to improve water quality, and lack of a focused approach to watershed restoration. Soil condition, riparian function and hazardous fuel reduction that poses a threat to water quality are not as likely to be maintained or improved as quickly as the other alternatives and only on an opportunity basis because plan language is either vague or lacking.
		B (modified), C, and D	Alternatives B (modified), C, and D would move water quality toward desired conditions faster than alternative A. This alternative improves the plan language deficiencies in alternative A by supporting improvements in watershed conditions, requiring implementation of ADEQ recommendations or an implementation plan to improve water quality, having a focus on priority watersheds, and directing that treated priority watersheds would trend toward properly functioning condition. Water quality would also be maintained by promoting functional riparian areas, characteristic disturbances, and reducing threats of uncharacteristic fire, and thereby reducing the risk of high soil burn severity which can cause accelerated erosion. This alternative establishes two management areas not present in alternative A (C.C. Cragin and Lake Mary Watersheds) and has improved direction for the Inner Basin MA. These three management areas emphasize surface water sources for the City of Flagstaff and for the Town of Payson. Management area language would emphasize protection of watershed condition and water quality.

[a] Recreational shooting does not include the use of firearms while legally pursuing wildlife during an open hunting season.

[b] This amount has been adjusted to eliminate any overlap between alternative A wilderness acres and alternative A seasonal closures.

[c] This amount has been adjusted to eliminate any overlap between alternative A acres (existing WAs and SCs), alternative C primitive and SPNM acres, alternative C Walnut Canyon Management Area acres, and alternative C Anderson Mesa Wildlife Habitat Management Area acres.

[d] WA = EWA + RWA; wilderness area acres = existing wilderness area acres + recommended wilderness area acres.

[e] There is an inverse relationship between short- and long-term smoke impacts to communities. The specific nature of the impacts would depend on the nature and location of the fire. In general, prescribed fires have lower concentration and duration of smoke compared to uncharacteristic fires that produce higher concentrations and duration of smoke. Alternatives that result in reduced prescribed fire treatments also reduce short-term smoke impacts; however, it is expected that they would lead to increased concentration and duration of smoke impacts to communities over the long term due to the buildup of fuels that result in larger uncharacteristic wildfires. In contrast, alternatives that increase short-term smoke impacts would likely reduce long-term smoke impacts because the potential for uncharacteristic wildfires would be reduced.

[f] Alternative A includes a unique ROS class called nonmanaged forest lands (NON-F). This ROS class was intended to represent all of the land within the administrative boundary of the forest but not managed by the forest. Over 8 percent of the forest (approximately 172,000 acres) falls into the NON-F ROS class. Alternatives B modified, C, and D do not use the NON-F ROS class, but instead they assign established ROS classes (e.g., urban, rural, roaded natural) to all lands within the administrative boundaries of the forest, including these nonmanaged forest lands. The plan does not have any authority over these lands unless they are part of the National Forest System. However, it is beneficial for the plan to inventory and identify recreation opportunities within these lands for a number of reasons, including maintaining a compatible recreation setting across landownerships and simplifying the process of setting management objectives for newly acquired or exchanged lands. Comparing alternative A to alternatives B (modified), C, and D requires recognition that some of the acres or percentages assigned to ROS classes in alternatives B (modified), C, and D may be higher than alternative A due to the inclusion of a portion of the NON-F lands.

[g] Although available for removal from P and SPNM areas, a site-specific, project-level decision is still necessary before action can be taken.

Table 2. Summary of effects

Resource	Alternatives A, B (modified), C, and D
Air Quality	
Smoke impacts	In the short term, alternative A would have fewer smoke impacts from wildfires followed by alternative C, but corresponding higher risks of smoke from uncharacteristic wildfires than alternatives B (modified) and D. In the long term, alternative A would have slightly more smoke impacts than alternatives B (modified) through D because it prohibits the use of wildfire with resource objectives in the wildland-urban interface that would lead to a greater risk of uncharacteristic wildfires in the long term.
Aquatic Systems	
Water quality, water quantity, and watersheds	Due to gaps in plan direction, continuing implementation of alternative A would not improve impaired water quality; maintain instream flows, or riparian, soil, and watershed function; or move water resource toward desired conditions as quickly as alternatives B (modified), C, and D.

Resource	Alternative A	Alternatives B (modified), C, and D
Biophysical features		
Management of significant cave resources	No specific guidance for management of significant cave resources	Significant caves will be managed to preserve criteria for which they were nominated.
Minimization of impacts to caves and sinkholes	300-foot buffer around cave entrances, but no clear direction that takes into account uncertainty and complexity of cave resources	300-foot buffer, or alternatively, cave surveys and/or site-specific information would be used to modify buffer to more appropriate site mitigation. Alternatives B (modified), C, and D are more likely to balance tradeoffs between surface management needs and protection of the cave resource.
Mitigation of accidental or past alterations of cave resources	No direction	Guideline to proactively mitigate accidental or past alterations of cave resources would prevent continued degradation of caves impacted by past human activities and would provide mitigation of impacts on cave resources accidentally damaged due to a lack of information on the resource, wildland fire effects, or other unintentional changes to cave conditions.
Direction for cliffs and talus slopes	No direction except maintenance of scenic views of red rock cliffs in Sedona area	Desired conditions, standards, and management approaches are included that will likely lead to better protection of cliffs and talus slopes.

Resource		Alternative A	Alternatives B (modified), C, and D
ERUs and Riparian Areas		**Departure From and Trend Relative to Desired Conditions**	
Ponderosa Pine	Vegetation	Moderate– Toward	(alternatives B modified, C, and D move toward DCs faster)
	Fire Severity		High – Toward
	Soil Condition/ Productivity	Low – Static (low objective) Toward (high range of objectives)	
Mixed Conifer with Frequent Fire	Vegetation	Moderate – Toward	Moderate – Toward (alternatives B (modified), C, and D move toward DCs faster)
	Fire Severity		High – Toward
	Soil Condition/ Productivity	Low – Slowly Toward	Low – Slowly Toward (with a faster rate at high objective)
Pinyon-Juniper with Grass	Vegetation	Moderate – Toward	
	Fire Severity	Moderate-High – Toward	
	Soil Condition/ Productivity	Low – Static (at low and high objectives)	
Montane/ Subalpine Grassland	Vegetation	Low – Away	Low – Toward
	Fire Severity	High – Away	High - Toward
	Soil Condition/ Productivity	High – Static	High – Toward
Great Basin Grassland	Vegetation	Low – Away	Low – Static
	Fire Severity	High -Away	High – Static
	Soil Condition/ Productivity	High – Slowly Toward	High - Toward
Semidesert Grassland	Vegetation	High – Static	High – Toward
	Fire Severity	Moderate - Static	Moderate – Toward
	Soil Condition/ Productivity	High – Slowly Toward	High – Toward
Interior Chaparral	Vegetation		Low – Away
	Fire Severity		Low-Moderate – Away
	Soil Condition/ Productivity	Low – Static	Low – Toward
Pinyon-Juniper Evergreen Shrub	Vegetation	Moderate – Away	
	Fire Severity	Moderate – Away	
	Soil Condition/ Productivity	High – Static	High – Slowly Toward (in treated areas, Static in other areas)
Pinyon-Juniper Woodland (Persistent)	Vegetation	Low – Static	
	Fire Severity	Moderate – Static	
	Soil Condition/ Productivity	High – Static	
Mixed Conifer with Infrequent Fire	Vegetation	Moderate – Away	Moderate – Static
	Fire Severity	High – Away	High – Static
	Soil Condition/ Productivity	Low – Static	Low – Slowly Toward

Resource		Alternative A	Alternatives B (modified), C, and D
Spruce-Fir	Vegetation	Moderate – Away	
	Fire Severity	Moderate – Away	
	Soil Condition/ Productivity	Low – Static	
Cottonwood Willow	Riparian Function	Moderate – Slowly Toward	
Riparian Forest*	Soil Condition/ Productivity	High – Slowly Toward	
Mixed Broadleaf Deciduous	Riparian Function	Low – Slowly Toward	
Riparian Forest*	Soil Condition/ Productivity	Low – Static	Low – Slowly Toward
Wetland*	Riparian Condition	By number,[a] Moderate – Slowly Toward	Low – Toward
		By acres,[b] Low – Slowly Toward	Low – Toward
	Soil Condition/ Productivity	High – Static	High – Toward
Alpine	Vegetation	Moderate – Away	
Tundra*	Soil Condition/ Productivity	Low – Static	
Desert	Vegetation	High – Away	
Communities*	Soil Condition/ Productivity	Moderate – Static	Moderate – Slowly Toward
Montane Willow	Riparian Function	Low Static to Slowly Toward	
Riparian Forest*	Soil Condition/ Productivity	Overall High (High for Montane, Low for Subalpine) – Static	Overall High (High for Montane, Low for Subalpine) – Slowly Toward
Species Viability			
Species Viability	All alternatives	were determined	to provide for species viability
Management		**Indicator Species**	**Habitat Quality and Population Determinations**
Pronghorn		Habitat Quality: Stable to Declining, Except Soils which is Stable to Increasing	Habitat Quality: Stable to increasing
		Population: Stable	
Mexican spotted owl		Habitat Quality: Increasing	Habitat Quality: Increasing (at greater rate than alternative A)
		Population: Stable	
Pygmy nuthatch		Habitat Quality: Stable to Slightly Increasing	Habitat Quality: Stable to increasing
		Population: Stable	

Scenery (acres) by visual quality objective (VQO) for alternative A and scenic integrity objective (SIO) for alternatives B (modified), C, and D)

Resource	Alternative A	Alternative B (modified)	Alternative C	Alternative D
Very High/Preservation	156,491 acres	208,421 acres	247,485 acres	207,573 acres
High/Retention	246,285 acres	669,408 acres	630,658 acres	669,797 acres
Moderate/Partial Retention	453,914 acres	953,811 acres	953,499 acres	951,777 acres
Low/Modification	930,661 acres	11,322 acres	11,320 acres	13,815 acres
Very Low/Max. Modification	65,735 acres	0 acres		

Recreation Opportunity Spectrum Setting (percentage of forest)

Resource	Alternative A	Alternative B (modified)	Alternative C	Alternative D
Nonmanaged Forest	8.6%	N/A		
Urban	NA	1%		
Rural	2%	4%		
Roaded Natural (RN)	41%	38%		
Semiprimitive Motorized (SPM)	36%	38%	37%	38%
Semiprimitive Nonmotorized (SPNM)	6%	11%	8%	11%
Primitive	8%	1%	5%	0%
Wilderness: Transition (WT)	0%	1.0%		
Wilderness: Semiprimitive (WSP)	0%	2%		
Wilderness: Primitive (WP)	0%	3%		
Wilderness: Pristine (WPS)	0%	2%		

Motorized Transportation System

Resource	Alternative A	Alternative B (modified)	Alternative C	Alternative D
Road open to public use	3,097 miles			
Road available for administrative or permitted use	4,387 miles			
Road open to public use potentially impacted by Semiprimitive Nonmotorized (SPNM) and Primitive (P) classification	56 miles	2.6 miles	14 miles	2.6 miles
Road available for administrative or permitted use potentially impacted by Semiprimitive Nonmotorized (SPNM) and Primitive (P) classification	86 miles	202 miles	203 miles	202 miles
Road open to public use potentially impacted by special area designations	24 miles	26 miles	26 miles	24 miles
Road available for administrative or permitted use potentially impacted by special area designations	33 miles	34 miles	34 miles	33 miles

Resource	Alternative A	Alternative B (modified)	Alternative C	Alternative D
Suitable for road construction	N/A	1,465,920 acres	1,109,467 acres	1,469,290 acres
Suitable for temporary road construction	N/A	1,665,046 acres	1,585,113 acres	1,681,450 acres
Suitable for motorized areas	N/A	713,842 acres	620,692 acres	712,810

Wilderness Areas

Resource	Alternative A	Alternative B (modified)	Alternative C	Alternative D
Existing wilderness acres	10 existing wilderness areas 156,374 acres			
Recommended wilderness acres	0 additional wilderness areas 0 acres	3 proposed wilderness areas 8,733 acres	13 proposed wilderness areas 91,757 acres	0 additional wilderness areas 0 acres

Wild and Scenic Rivers (WSR)

Resource	Alternative A	Alternative B (modified)	Alternative C	Alternative D
Existing WSR mileage per plan language	43.5 miles			
Eligible WSR mileage per plan language	180.9 miles			

Research Natural Areas (RNAs) and Botanical, Geologic, and Environmental Study Areas

Resource	Alternative A	Alternatives B (modified) and C	Alternative D
Proposed RNAs per plan language (number and acreage)	4 existing RNAs 3,622 acres		
Proposed RNAs per plan language (number and acreage)	2 proposed RNAs 1 expansion of an existing RNA 1,981 acres	2 proposed RNAS 1 expansion of an existing RNA 2,074 acres	
Existing botanical areas per plan language (number and acreage)	4 botanical areas 1,746 acres		
Proposed botanical areas per plan language (number and acreage)	0 proposed botanical areas 0 acres	1 proposed botanical area 578 acres (combined with proposed geological area – 763 acres total)	0 proposed botanical areas 0 acres
Existing geologic areas per plan language (number and acreage	1 geologic area 1,201 acres		
Proposed geological areas per plan language (number and acreage)	0 proposed geological areas 0 acres	1 proposed geological area 185 acres (combined with proposed botanical area - 763 acres total)	1 proposed geological area 185 acres
Existing environmental study areas per plan language (number and acreage)		3 environmental study areas 1,577 acres	

Resource	Alternative A	Alternatives B (modified) and C	Alternative D
Proposed environmental study areas per plan language (number and acreage)		0 proposed environmental study areas 0 acres	

Resource	Alternative A	Alternative B (modified)	Alternative C	Alternative D
Minerals				
Portion of forest open to mineral entry	1,563,877 acres 85% of forest	1,554,381 acres 85% of forest	1,473,371 acres 80% of forest	1,563,692 acres 85% of forest
Existing and potential new withdrawals from mineral entry	273,621 acres 15% of forest	283,117 acres 15% of forest	364,127 acres 20% of forest	273,806 acres 15% of forest
Timber				
Lands suitable for timber production	466,100 acres	522,174 acres	464,841 acres	522,529 acres
Allowable sale quantity (ASQ) (CCF = hundred cubic feet)	175,723 CCF for first decade	196,809 CCF for first decade	175,396 CCF for first decade	196,809 CCF for first decade
Long-term sustained yield capacity (LTSYC)	96,337 CCF	107,929 CCF	96,085 CCF	107,994 CCF
Forest Products				
Harvest—softwood sawtimber	41,251 CCF	167,222 CCF		
Harvest—softwood pulp	5,745 CF	25,789 CCF		
Harvest—hardwood sawtimber	0 CCF			
Harvest—hardwood pulp	0 CCF			
Poles	24 CCF			
Posts	25 CCF			
Firewood	10,625 CCF			
All other products	122 tons			
Range				
Permitted head months	128,690 HMs	128,690 HMs	128,690 HMs	128,690 HMs
Acres of range allotments with prohibition on motor vehicle use for range management	0	0	0	0
	Forest Resource	**Present Net Value**	**(PNV)**	
Total PNV of all forest resources (range, recreation, minerals, timber, nonrecreation related special uses)	$(21,983,082)	$(20,353,777)	$(22,100,352)	$(20,353,777)

[a]"By number" indicates that departure and trend are determined across the actual number of individual wetlands/cienegas on the landscape.

[b] "By acres" indicates that departure and trend are determined across the total amount of acreage of wetlands/cienegas on the landscape.

*ERU not fire-adapted.

Chapter 3. Affected Environment and Environmental Consequences

This chapter summarizes the physical, biological, social, and economic environments of the planning area and the effects of implementing each alternative to that environment. It also presents the scientific and analytical basis for the comparison of alternatives presented in chapter 2. Information in this chapter is based on resource reports and other supporting material that are located in the project record. Methodologies used in this analysis are described in "Appendix C: Methodology and Analysis Process."

Specialist reports[11] were developed for many resource areas as part of the environmental impact statement process and information from those reports was used to create the DEIS. Subsequently, the specialist reports were edited per review-driven edits to the broader FEIS. There may still be an instance where the information in the specialist reports does not exactly match that of the FEIS. Should this situation arise, the FEIS contains the most up-to-date information.

The land management plan provides a programmatic framework that guides site-specific actions but does not authorize, fund, or carry out any project or activity. Because the land management plan does not authorize or mandate any site-specific projects or activities (including ground-disturbing actions), there can be no direct effects. However, there may be implications, or long-term environmental consequences, of managing the forests under this programmatic framework. Those environmental consequences are described in this chapter. Consequences are based on predicted implementing activities and are meant to compare alternatives on a programmatic level, rather than provide exact measurements of effects.

The analysis included in this chapter frequently refers to specific plan components that are included in the various alternatives. To make inclusion of these references easier and more uniform, a shorthand citation system is used throughout this document. For alternative A, when specific plan language is being referenced, the analysis will include information in parentheses indicating on which page(s) the referenced plan component(s) can be found (e.g., 1987 Plan, page 1). For alternatives B (modified), C, and D, codes have been assigned to each plan component to reference and visually distinguish plan decisions more easily. Abbreviations are used in each code to identify: (1) if a plan decision applies forestwide (FW) or within a particular management (MA) or special (SA) area; (2) the applicable resource area (e.g., Air, Soil, etc.); and (3) type of plan decision (i.e., desired condition (DC), objective (O), standard (S), or guideline (G)). The last part of each code is a number. For example "FW-Air-Qual-DC-1" refers to the forestwide direction for air quality, desired condition number 1; "MA-FlagN-O-2" refers to the management area direction for Flagstaff Neighborwoods, objective number 2; "SA-WSR-Verde-S-1" refers to the special area direction for the Verde Wild and Scenic River, standard number 1.

Assumptions

The following assumptions were made for this analysis:

- Land management plans do not have direct effects. They do not authorize or mandate any site-specific projects or activities (including ground-disturbing actions). However, there may be

[11] These individual specialist reports may be found at the following website: https://go.usa.gov/xRPZd

implications, or longer term environmental consequences, of managing the forests under this programmatic framework.

- The plan decisions (desired conditions, objectives, standards, guidelines, management areas, suitability determinations, monitoring) will be followed when planning or implementing site-specific projects and activities.
- Law, policy, and regulations will be followed when planning or implementing site-specific projects and activities.
- Funding levels will be similar to the past 5 years.
- The planning timeframe for the effects analysis is 10 to 15 years; other timeframes may be specifically analyzed depending on the resource and potential consequences.
- Monitoring identified in the "Monitoring" chapter will occur and the land management plan will be amended, as needed during the life of the plan.

Cumulative Effects Common to All Resources

"Cumulative effects" is defined in the White House Council of Environmental Quality's NEPA regulations as the "impact on the environment that results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions…" 40 CFR 1508.7. The Council on Environmental Quality interprets this regulation as referring only to the cumulative impact of the direct and indirect effects of the proposed action and its alternatives when added to the aggregate effects of past, present, and reasonably foreseeable future actions on all landownerships across an area that is deemed appropriate for the impacts being analyzed.

The analysis conducted for this project follows the "Guidance on the Consideration of Past Actions in Cumulative Effects Analysis" issued by the Council on Environmental Quality Chairman on June 24, 2005 (CEQ 2005). The guidance states the expectation that agencies determine what information regarding past actions is useful and relevant to the required analysis of cumulative effects and further notes that Council on Environmental Quality regulations do not require agencies to catalogue or exhaustively list and analyze all individual past actions. Because the geographic area of consideration varies by resource, the analysis of cumulative effects for each resource may differ in temporal and spatial scale, as well as the activities that are considered in cumulative effects discussions for each resource.

The cumulative effects analysis contained in this chapter does not attempt to quantify the effects of past human actions by adding up all prior planning actions on an action-by-action basis. In order to understand the contribution of past planning actions to the cumulative effects of the proposed action and alternatives, this analysis relies on current environmental conditions as a proxy for the impacts of past planning actions. This is because existing conditions reflect the aggregate impact of all prior human actions and natural events that are difficult to quantify that have affected the environment and might contribute to cumulative effects. Unless otherwise identified, cumulative effects are considered for the expected life of the revised plan (10 to 15 years).

Air Quality

This section will focus on three air quality topics related to the Coconino NF and its management. Smoke from wildfires and prescribed fires on the forest can affect air quality in and near the forest. Smoke can also affect visibility in areas on or near the forest. Finally, forest management activities can impact air quality on or near the forest from emissions other than smoke.

Background

The Clean Air Act of 1963 (P.L. 88-206) requires the Environmental Protection Agency (EPA) to set up National Ambient Air Quality Standards (NAAQS) to protect public health. There are six criteria pollutants for which these standards have been set: (1) carbon monoxide (CO), (2) lead, (3) nitrogen dioxide (NO_2),[12] (4) particulate matter smaller than 10 micrometers in diameter (PM_{10}) and particulate matter larger than 2.5 micrometers in diameter ($PM_{2.5}$), (5) ozone, and (6) sulfur dioxide (SO_2). These standards set the maximum average volume of the pollutant that is acceptable for sensitive populations, such as people with asthma and children and the elderly, over a given period of time. This measure is known as the concentration level of the primary standards. Secondary standards may also be set for protection of general welfare, which particularly shows the concentration that affects visibility, and damage to buildings, plants, and animals.[13]

This analysis includes disclosure of effects on air quality from forest activities whose emissions are regulated by the Clean Air Act and those that are not, because both can produce emissions that impair air quality and, thus, indicate potential impact to human health and wildlife, such as nesting birds. Although some activities (such as vegetation treatments using mechanical equipment) produce very low emissions individually, those activities can cumulatively contribute to air quality effects.

The Regional Haze State Implementation Plan (ADEQ 2003) is designed to prevent future impairment of and remedy existing impairments of visibility, including smoke. It addresses acceptable levels of criteria pollutants that affect visibility such as particulate matter. The forest's responsibility under the State implementation plan to meet air quality regulations requires coordination with the EPA and other air regulatory agencies (State, county, and tribal), such as Arizona Department of Environmental Quality (ADEQ). Coordination efforts involve managing and mitigating air pollution from Forest Service activities through adherence to EPA standards and State-specific regulations. For example, the forest works with ADEQ and follows Arizona's Forest and Range Management Burn Rule.[14] Prescribed fires and wildfires have the potential to produce smoke that impacts air quality. The magnitude of smoke is dependent on the amount of fuels consumed, type of fuels, extent, weather at the time of the fire, and duration. Only prescribed fire activity is typically regulated for smoke management (e.g., visibility and criteria pollutants) because wildfires are considered "natural events," which are excluded under the NAAQS regulations. However, sustained exceedance of air quality standards, such as a wildfire, may be investigated by EPA to determine if it is an exceptional event.

Areas that persistently exceed NAAQS for a criteria pollutant are called nonattainment areas. These areas must have a plan to meet the standard in the future and they may have additional regulations to control air emissions (Clean Air Act). For example, emission testing for vehicles is a common requirement in nonattainment areas for ozone and carbon monoxide. Existing nonattainment areas are identified on figure 2. They are south of the Coconino NF and upwind of the prevailing winds.

[12] NO_2 is an ozone precursor, meaning that over time it breaks down into ozone.
[13] See appendix C for current concentration standards (EPA 2011).
[14] See ADEQ's website: http://www.azdeq.gov/environ/air/smoke/download/prules.pdf

Affected Environment

Smoke Management

Arizona is divided into 11 smoke management units (SMUs) (figure 2). The Coconino NF occurs within 3 SMUs: Colorado River Airshed (1), Little Colorado River Airshed (3), and Verde River Airshed (5). The forest's fire activity impacts the above 3 SMUs regularly. Also, it infrequently impacts the Lower Salt River Airshed (SMU 6). The Air Quality Division of Arizona Department of Environmental Quality considers airshed impairment across northern Arizona to be low (see figure 2) (USDA Forest Service 2009a). The current air quality conditions of the airsheds overlapping the forest are within the national standards for all criteria pollutants.

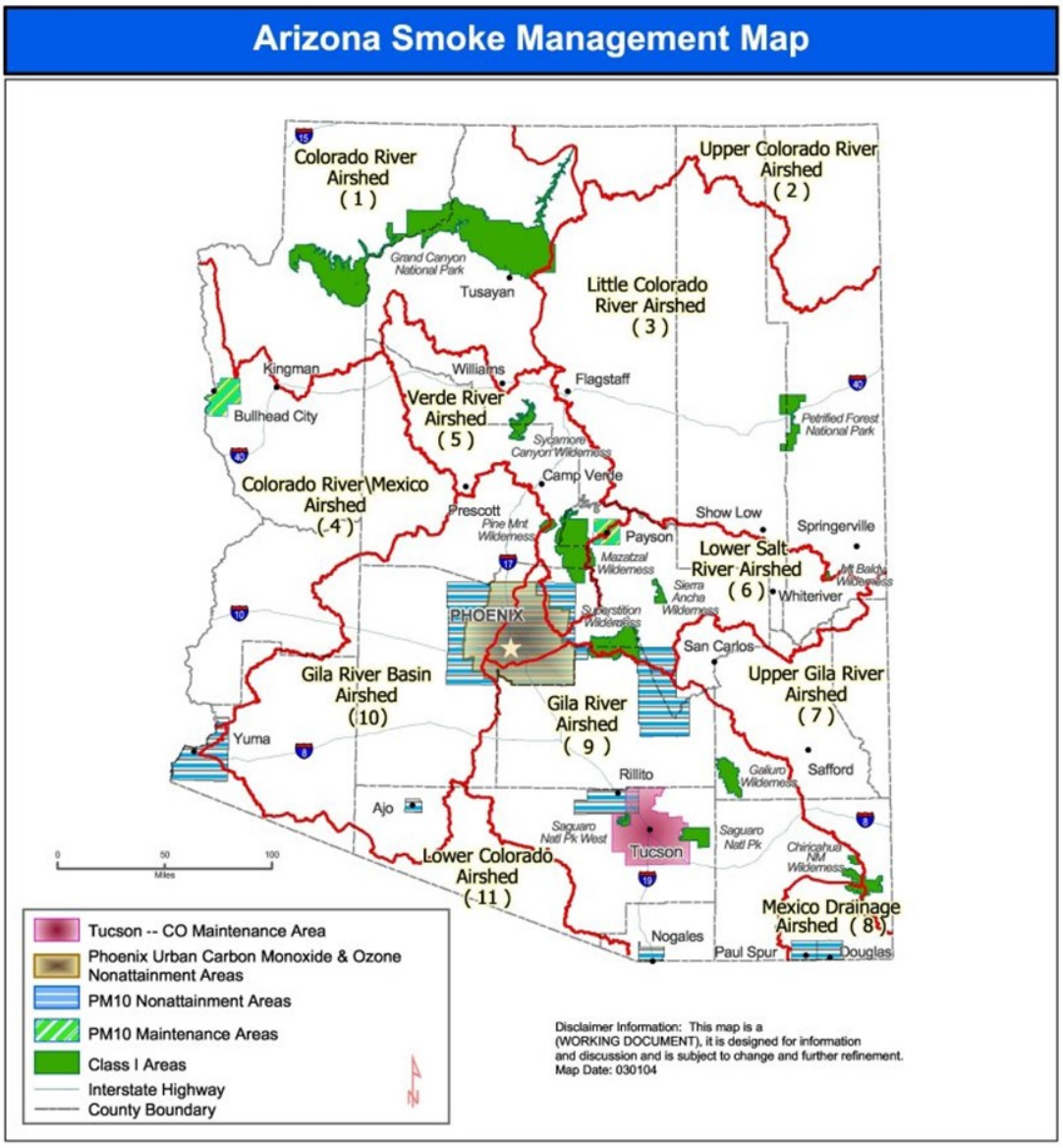


Figure 2. Arizona smoke management map

Prescribed fires and wildfires managed to meet resource objectives may produce temporary, but significant, amounts of smoke that contain particulate matter and carbon monoxide within the

planning area. Prescribed fires and wildfire managed for resources objectives may also produce a limited amount of ozone, but typically not in concentrations that are a concern for air quality standards.

The Forest Service coordinates with Arizona Department of Environmental Quality on the management of wildfires and may use emission reduction techniques to mitigate their impact on air quality (USDA Forest Service 2002b). Close coordination between the Agency and the regulatory entity ensures an adaptive management strategy that is responsive to changing conditions that affect the production and retention of smoke.

Prescribed fire activity (planned ignitions) on the Coconino NF is the only air quality activity directly regulated by the Arizona Department of Environmental Quality at this time. The forest averaged 19,143 acres of prescribed fire per year over the last 3 years, with the majority occurring in the Ponderosa Pine ERU.[15] The emissions from implementing any of the prescribed burns meet NAAQS, because the size of the burn area and weather conditions under which burning occurs are approved by the Arizona Department of Environmental Quality. Over the last 10 years, the prescribed fire activities on the Coconino NF have only resulted in one exceedance of the PM_{10} standard and no exceedances for other criteria pollutants. Therefore, the current fire activities on the Coconino NF are not significantly contributing to a future nonattainment status of the local area. Under current management, airsheds that involve the Coconino are functioning and would continue to function in a way that contributes to ecosystem resiliency and diversity over time. (USDA Forest Service 2009a).

Visibility

A Class I area is an area classification that requires the highest level of protection under the Clean Air Act of 1963, as amended. Projects that may potentially impact Class I areas must address efforts to minimize smoke impacts on visibility. In 1977, Congress designated all wilderness areas over 5,000 acres and all national parks over 6,000 acres in existence at that time as mandatory Federal Class I areas. There are two Class I areas on the Coconino NF, the Sycamore Canyon Wilderness and the Mazatzal Wilderness. The forest infrequently impacts these Class I areas due to predominant wind patterns originating from the southwest and blowing toward the northeast, carrying any smoke away from these two areas.

There are several Class I areas near the Coconino NF. The Pine Mountain Wilderness is a Class I area in the Verde River Airshed, located less than 20 miles of the Coconino NF. Petrified Forest National Park is a Class I area within the Little Colorado River Airshed, located about 120 miles east of the Coconino NF. These Class I areas are very rarely impacted by Coconino NF fire activities (at a concentration that would adversely affect visibility) due to their distance (which allows smoke to disperse before it gets to these areas) and relative location (which allows prevailing winds to carry smoke away from these areas).

[15] The Coconino NF has a high diversity of vegetative communities (also called vegetation types or ecological response units (ERUs)) due to its wide range of elevations, complex topography, and presence of perennial water. Fire (and consequently, smoke) was a natural disturbance that maintained reference conditions in the following 11 fire-adapted ERUs: Semi-desert Grassland, Great Basin Grassland, Montane/Subalpine Grassland, Interior Chaparral, Pinyon Juniper with Grass, Pinyon-Juniper Evergreen Shrub, Pinyon-Juniper Woodland (Persistent), Ponderosa Pine, Mixed Conifer with Frequent Fire, Mixed Conifer with Infrequent Fire, and Spruce-Fir. Additional information on each of this ERUs, their natural fire regime, and their current condition is included below in the Vegetation and Fire section.

Other Forest Activities that Affect Air Quality

Mechanical treatments used for ecosystem restoration activities require the use of diesel-powered heavy equipment in order to be carried out in a cost-effective manner. It results in the release of particulate matter, CO and NO_2 from combustion engines, and fugitive dust from the construction and use of National Forest System roads. The impact of this equipment to air quality is short-term and would not result in significant effects to air quality. Mechanical treatment emissions typically produce lower concentrations than from fire-related treatments, when treating an area of comparable size (CEQ 2011).

Fugitive dust is the detachment of soil particles as a result of human-caused or wind-driven disturbance of bare soil. It is termed "fugitive" because it does not come out of a pipe, duct, smoke stack, etc. Two human activities increase the generation of fugitive dust above natural levels: (1) the creation of bare soil through road building, tillage, construction activities, etc., and (2) the disturbance of bare soil by wheels, blades, etc. (EPA 2009). Fugitive dust is not a regulated form of particulate matter in Arizona, but it does contribute to PM_{10}. Control techniques for fugitive dust include watering, dust abatement, chemical stabilization, and windbreaks. Forested areas with overstory vegetation that provides natural windbreaks, protective vegetative ground cover, and less bare soil have less potential to produce fugitive dust than more open areas with large areas of bare soil or intermittent bare soil.

Fugitive dust from vegetation treatments is not a major concern on the Coconino NF for several reasons. The understory conditions of the vegetation types that dominate and are most likely to be treated (ponderosa pine and mixed conifer frequent fire ERUs) on the Coconino NF do not support long distance transport of dust and have more moisture and protective vegetative ground cover to preserve soil aggregate stability than in pinyon-juniper woodland, semidesert grassland, and desert ERUs.

The forest's road system is the most likely contributor to fugitive dust in semiarid and arid ERUs, including the Semi-desert Grassland, Desert Communities, Interior Chaparral, and Pinyon-Juniper ERUs. Of particular concern on the Coconino NF, are the fine sandy loam surfaces of the Supai formation (generally found in the Pinyon-Juniper woodland ERUs near Sedona), calcareous soils of the Verde Formation, and calcareous surfaced alluvial soils. Calcareous soils are distinguishable by their white powdery color, high pH and loam or sandy clay loam surface textures. These soils have high or very high wind erodibility, are naturally loose and detached, and are easily transported by wind. Roads on these soil types would have the greatest potential contribution to fugitive dust.

Campfire smoke in narrow canyons that have a lot of recreation use has also been a nuisance issue related to air quality on the Coconino NF. The forest has restrictions in place in the Oak Creek Canyon and the Sedona Neighborwoods Management Areas to limit campfires to designated campsites, of which there are very few. Another localized air quality issue is the effect of smoke on nesting birds. This has been a consideration in the planning of prescribed fire ignitions for the last 15 years in the Sedona/Oak Creek Management Area.

Environmental Consequences

The following environmental consequences are limited to the administrative boundaries of the Coconino NF and assessed in the short term (15 years) followed by the long term (50 years).

Smoke Management

Fire is a critical evolutionary force that has helped shape the vegetation of the Coconino NF. The resiliency of much of the forest is dependent upon fire as a natural disturbance.

The smoke produced from fire and the Coconino NF's ability to manage it depend on two factors: type of fire (prescribed fire or wildfire) and uncharacteristic fire. Prescribed fire treatments occur in locations where fire can be managed to occur at appropriate levels for the affected ERUs. Wildfires are all fires except prescribed fire. Some wildfires occur in areas and conditions that can be managed for resource objectives. Other wildfires occur in areas where conditions may result in impacts outside of the natural fire regime, also referred to as uncharacteristic fire. Uncharacteristic wildfires in fire-adapted ERUs are wildfires whose frequency, severity, and/or extent are substantially different from those to with which a given ERU has evolved. For example, in ERUs that are adapted to frequent, low-severity fires, such as ponderosa pine and mixed conifer with frequent fire, then high-severity fires over large areas would be considered uncharacteristic. Similarly, in ERUs adapted to high-severity fires, such as spruce-fir, then low-severity fires would be generally uncharacteristic, though they may be desirable under certain conditions, such as in wildland-urban interface. In ERUs like interior chaparral, very large high-severity burn patches, would be uncharacteristic where historically, the burn patches were smaller. Wildfires in ERUs not adapted to fire like Alpine Tundra or Desert Communities ERUs would also be uncharacteristic. In most cases, wildfire in riparian areas would also be uncharacteristic.

Smoke impacts associated with fire treatments (prescribed fire treatments and wildfires managed for resource objectives) can be managed in a number of ways, which can help control smoke impacts. These emission reduction techniques (ERT) are discussed under Common to All Alternatives below.

The majority of the Coconino NF is covered by Ponderosa Pine and Mixed Conifer with Frequent Fire ERUs. While these ERUs are adapted to frequent low-severity fire, uncharacteristic wildfires in them (high-severity fires over large areas) produce more concentrated and toxic smoke impacts that can exceed air quality thresholds. It is assumed that because prescribed fires and wildfires managed for resource objectives generally do not cause concentrations of particulate matter exceeding air quality thresholds, the effects associated with these fires are of a lower magnitude than uncharacteristic wildfires.

The potential for uncharacteristic wildfires can be affected by fire treatments. Fewer fire treatments in fire-adapted ERUs, i.e., longer intervals between fires or missed fire return intervals, lead to a buildup of fuels. Uncharacteristic wildfires can be the result once fire is re-introduced or a wildfire occurs. In contrast, alternatives that result in increased fire treatments in fire-adapted ERUs lead to a reduction of fuels. This approach does a better job of restoring fire-adapted ERUs departed from their desired conditions by reducing the risk for uncharacteristic wildfires.

The exact magnitude, extent, and location of smoke effects is difficult to assess at the plan scale because the effects are largely dependent on the site-specific situation and how individual fire incidents are addressed. Alternatives that result in reduced prescribed fire treatments and wildfires managed for resource objectives would reduce smoke impacts associated with these characteristic fires in the short term, but also would lead to an increase in smoke impacts associated with uncharacteristic fires to communities in the long term.

Common to All Alternatives

In the short term, there would be no difference in how alternatives affect air quality in terms of protecting human health, since NAAQS are set at levels that are necessary to meet that objective and the forest must also meet NAAQS standards. Under all alternatives, regardless of the number of acres treated, prescribed fires would be managed to meet the Coconino National Forest's legal obligations for air quality. Alternative A provides guidance, to "Manage smoke from prescribed fire to meet legal standard and to provide for public safety." See 1987 plan, page 92. Alternatives B (modified), C, and D also have direction for the forest to meet these legal obligations, "Air quality on

the Coconino NF meets state air quality standards for visibility and public health. Air quality related values, including high quality visual conditions, are maintained with the Class I Areas." See FW-Air-DC-1. These obligations pertain specifically to the management activity of prescribed burning. Due to prevailing wind conditions, prescribed fire activities and wildfires on the Coconino NF would rarely affect the nonattainment portion of the SMU 5 under any alternative (see figure 2).

There would be no difference in the effects of the plan alternatives on smoke from wildfires managed for resource objectives in the short term (up to 15 years). Because wildfires are considered to be natural events, they are not directly regulated by ADEQ or EPA. However, on wildfires managed for resource objectives, fire managers still manage emission production by implementing ERTs. The use of ERTs depends on the objectives of a fire, but they are less likely to be used where objectives focus on protecting values-at-risk (like safety, life, and property) and more likely to be used where objectives are based on resource benefits. Some examples of ERTs used to reduce emissions include burning when atmospheric conditions are optimal, or limiting these operations when ventilation is poor. Utilization (any activity that removes biomass prior to fire treatment) is also an emission reduction technique. Utilization would reduce the amount of smoke in both the short and long term due to a decrease in available fuel. There would be no difference between alternatives regarding the reduced smoke associated with utilization. Greater utilization would be directly related to decreased smoke. Even though only alternatives B (modified), C, and D specifically point to use of these techniques (see FW-Air-G-1), alternative A's silence on the issue has not impeded their implementation because of the forest and ADEQ's roles and involvement of smoke issues for these fires.

ERTs provide the forest with tools to manage smoke levels on wildfires managed for resource objectives and prescribed fires. Accordingly, smoke levels coming from wildfires managed for resource objectives and prescribed fires are generally lower than smoke levels coming from uncharacteristic wildfires. While the lower level of smoke associated with wildfires managed for resource objectives and prescribed fires can certainly have impacts where it occurs, it generally meets state air quality standards. On the other hand, uncharacteristic wildfires produce more concentrated and toxic smoke impacts that can exceed air quality thresholds. It is assumed that because prescribed fires generally do not cause concentrations of particulate matter exceeding air quality thresholds, prescribed fire effects are of a lower magnitude than uncharacteristic wildfires.

Particulate matter is the primary pollutant of concern in fire management and the most likely to result in health and visibility effects. Particulate matter is very fine solid particles suspended in smoke. $PM_{2.5}$ particles, in particular, can become lodged in the deepest part of the respiratory system and are difficult for the body to expel (USDA Forest Service 2002b).

CO production and particulate matter are expected to be higher when more fuels are consumed, as demonstrated by wildfires such as the Schultz Fire (2010) or Wallow Fire (2011). Wildfires are unpredictable in terms of the timing, frequency, and size of their occurrence, but they are less likely to occur in areas that have been treated in a manner that results in vegetative structure, composition, and fuel loads that approximate historic conditions of the given vegetation type. Typically, prescribed fires and wildfires managed for resource objectives have lower emissions in dry frequent fire forest types than fires with uncharacteristic fire behavior and fire effects (Lata 2014).

The amounts of CO and particulate matter produced from fires are roughly similar among alternatives in the short term because of regulations and the consistent application of emission reduction techniques, but long-term effects of the alternatives are variable. Constraints like environmental and fuel conditions, fire leadership and resource availability and socio-political concerns would limit such opportunities, and do not vary across alternatives.

Alternative A

In the short term, alternative A would have the least low-level smoke impacts to communities from wildfires, mainly due to restrictions on where wildfires can be managed for resource objectives and a general lack of emphasis on the ecological need for fire as a natural disturbance. Alternative A explicitly prohibits using wildfires managed for resource objectives in the wildland-urban interface (wildland-urban interface). See 1987 Plan, page 137. Therefore, this alternative would tend to have fewer days with smoke impacts to communities due to the fact that wildfires managed for resource objectives would be farther away from communities. This increases the likelihood that ventilation would lower concentrations of smoke in the wildland-urban interface. Fire would only be permitted in wildland-urban interface when it is the result of a planned ignition under this alternative. Over the long term, not allowing wildfires managed for resource objectives in the wildland-urban interface as a treatment option could allow fuels to build up especially if no vegetation or prescribed fire treatments had occurred. The risk of uncharacteristic wildfire in fire-adapted ERUs would increase and compared to the lower severity effects that are typical when wildfires are managed for resource objectives, uncharacteristic wildfires would produce larger amounts of smoke. In wildland-urban interface, not allowing wildfires to be managed for resource objectives would require more use of mechanical thinning to meet vegetative desired conditions and protect human life and property. Mechanical thinning results in different emissions (NO_2, CO, and PM from dust) that would have a lower impact on human health because they occur in lower volumes than emissions from fire and at a slower rate.

Alternative A also limits managing wildfires for resource objectives in 156,374 acres of existing wilderness. See 1987 Plan, page 112. In the short term, this limitation would likely result in fewer days with lower level smoke impacts from wildfires in wilderness and areas adjacent to wilderness because wildfires would be suppressed rather than managed for resource objectives. The ability to use mechanical equipment and prescribed fire for fuels reduction in wilderness is also restricted by the Wilderness Act of 1964 (P.L. 88-577) and Forest Service policy (FSM 2324.23). These restrictions would reduce the forest's ability to restore fire-adapted ecosystems in designated wilderness areas and/or result in higher costs which could limit the number of acres that could be treated. Fire return intervals could be missed resulting in stand structure that is more vulnerable to uncharacteristic wildfire or insect and disease outbreaks outside the historic range of variability. Structure characteristics would include increasingly dense stands of trees, more contiguous canopy, tree mortality, and higher amounts of dead and downed fuel. In the long term, wildfires could increase the forest's contribution to smoke from fires within wilderness areas. Uncharacteristic wildfires in fire-adapted ERUs are harder to control due to the dry conditions under which they typically burn. As a result, they burn larger areas, consume more fuel and, therefore, produce more smoke. Even though there may be fewer days of smoke impacts because of these restrictions, the increased potential for uncharacteristic wildfires that can occur as a result of these restrictions would produce higher amounts of smoke compared to the lower amounts of smoke associated with the lower severity fires that typify wildfires managed to achieve resource objectives.

Alternative A does not recommend any new wilderness areas for the Coconino NF. Accordingly, there would be no additional limitations on vegetation management, such as mechanical treatment, prescribed fires, or wildfires managed for resource objectives, due to recommended wilderness areas. As a result, in the short term, vegetation treatments and associated lower levels of smoke may be more frequent in the areas that alternatives B (modified) and C recommend as wilderness areas. This combination of mechanical treatment and more frequent fire could reduce uncharacteristic fire behavior, which would result in less smoke from these areas in the long term.

Alternative A has the least area of the forest managed for an unroaded recreation setting. These areas include areas with an ROS setting of semi primitive non-motorized (SPNM) and primitive (P), as well as designated wilderness areas. Prescribed fire and mechanical treatments could occur in SPNM and P ROS areas, but they would require more post-treatment mitigation efforts to restore the desired recreation setting. Prescribed fire and mechanical treatments could also occur in designated wilderness areas if they are conducted in a manner compatible with overall wilderness management objectives. See FSM 2324.23. If controlling costs is a major constraint on whether or not the work is completed, projects designed in these areas may be less intensive or fewer acres would be treated adequately to restore historic conditions. This would result in fewer days with low-level smoke impacts over the short term from treatments to these areas. However, applying less intensive treatments or treating fewer acres would result in a higher risk of uncharacteristic wildfire in these areas over the long term, which would produce higher levels of smoke than lower severity fires. Furthermore, because alternative A has the least area of the forest managed for an unroaded recreation setting, it has the fewest acres where costs may be a constraint to treatments. If landscape-scale projects, which would allow the forest to treat at the upper end of objectives in the plan, can be designed to offset those expenses, these areas are more likely to be treated.

To the extent that plan direction under alternative A would limit or reduce treatments or the use of wildfires managed for resource objectives in WUI, designated wilderness areas, or areas managed for unroaded recreation setting, it would make it less likely that the forest would be able to meet these levels of treatment compared to the other alternatives that do not contain this direction. Accordingly, there could be fewer days with low-level smoke impacts and fewer acres treated in the short term compared to the other alternatives. Consequently, long-term smoke impacts from fire treatments under alternative A could be greater than the other alternatives as untreated areas would lead to more uncharacteristic fires, which produce more smoke in a shorter period of time. The smoke from uncharacteristic fires can be significant and may exceed air quality thresholds.

Alternative B (modified)

Alternative B (modified) has the potential to have slightly more days with low-level smoke impacts on communities in the short term than alternative A. This is because alternative B (modified) would allow wildfire to be managed for resource objectives in the wildland-urban interface. As a result, depending on the number of natural ignitions, there may be more frequent low-intensity fires managed in these areas. Managing natural ignitions in fire-adapted ERUs for resource objectives would result in reduced fuels, reduced risk to life and property, and reduced risk of uncharacteristic wildfire over the long term. Due to this reduced risk, alternative B (modified) would have slightly fewer days with high level smoke impacts on communities in the long term than alternative A. The risk to life and property from uncharacteristic wildfire would also be lower over the long term.

Alternative B (modified) provides a greater opportunity for fire treatment than alternative A because it does not constrain the use of wildfires managed for resource objectives in wilderness with restrictions on tactical strategies. It leaves those decisions more appropriately to comply with the Minimum Impact Suppression Tactics and Minimum Requirements Decision Guide processes, used throughout the Forest Service to identify which tools are necessary to achieve fire management and safety objectives while keeping consistent with policy to use the methods that cause the least impact in wilderness. This direction provides flexibility to fire managers without sacrificing wilderness character. As a result, under alternative B (modified) wildfire would play a more natural role in these ecosystems. This alternative also emphasizes the ecological need of frequent fire in appropriate ERUs than under alternative A. Compared to alternative A, the flexibility to use wildfires managed for resource objectives in wilderness would result in more days with low-level smoke impacts from

fires in wilderness areas in the short term and fewer days with high-level smoke impacts associated with uncharacteristic fires in the long term.

Alternative B (modified) recommends 8,733 acres of new wilderness. These recommended wilderness areas overlap ERUs that are moderately or highly departed from their historic fire regime. Constraints placed on the transportation system and on the expansion of motor vehicle use and mechanical treatment in recommended wilderness would increase the cost of treatment in these areas. These increased costs would result in fewer acres being treated, which would reduce the ability of the forest to meet resource objectives to restore fire-adapted ecosystems in those recommended wilderness areas. Under alternative B (modified), only 4,997 acres of the recommended wilderness areas would be in ERUs that have objectives related to mechanical and prescribed fire treatment (Ponderosa Pine and Pinyon Juniper with Grass). See FW-TerrERU-PJ-O-1, FW-TerrERU-PP-O-1, and FW-TerrERU-PP-O-2. Compared to alternative A, reduced treatment on these 4,997 acres would decrease the number of days of lower-level smoke impacts in the short term, due to decreased treatments, and increase the days of high-level smoke from them in the long term, due to the increased risk of uncharacteristic wildfire.

Alternative B (modified) proposes to manage more of the forest for an unroaded recreation setting than alternative A. Alternative B (modified) would manage 372,021 acres in the SPNM and P ROS categories and in designated and recommended wilderness while alternative A would manage 276,582 acres in the SPNM and P (which includes designated wilderness) ROS categories. The smoke effects would be similar because of the uncertainty about the outcome of this allocation on ecological restoration activities. Unlike in alternative A, permanent road construction under alternative B (modified) would not be suitable in these areas. Additional mitigation would be needed to restore areas disturbed by road construction to their desired settings. This has the potential to increase the cost of treatments in these areas under alternative B (modified). Like alternative A, increased costs for treatments in these areas may lead to less intensive treatments, or fewer acres would be treated adequately to restore historic conditions. Compared to alternative A, reduced treatment on these 95,409 acres would decrease the days of low-level smoke from them in the short term, due to decreased treatments, and increase the days of high-level smoke from them in the long term, due to the increased risk of catastrophic wildfire.

Overall, in the short term, there are likely to be more days of low-level smoke under alternative B (modified) than under alternative A. Like alternative A, there is plan direction that may limit treatments or wildfires managed for resource objectives in designated and recommended wilderness areas, or areas managed for unroaded recreation setting. Also, like alternative A, it is assumed that the forest would treat 15,000 to 30,000 acres a year using prescribed fire and 15,000 more acres a year using wildfires managed for resource objectives. However, even with these similarities, alternative B (modified) does not contain the other plan direction in alternative A that limits the management of wildfires for resource objectives. Accordingly, alternative B (modified) is likely to treat more acres than alternative A. This higher level of treatment would result in more days with low-level smoke impacts in the short term. Long-term smoke impacts from fire treatments would be lower than alternative A due to the increased level of treatment in the short term. The increased treatment would lead to fewer uncharacteristic fires, which produce high-level smoke that can exceed air quality thresholds. Accordingly, smoke produced as a consequence of alternative B (modified) would be less likely to exceed air quality thresholds than alternative A.

Alternative C

Like alternative B (modified), alternative C would allow wildfires managed for resource objectives in the wildland-urban interface, and therefore, would have similar associated smoke impacts on

communities (both short term and long term). Alternatives C and B (modified) would also have similar short-term and long-term smoke impacts related to fire treatment opportunities in designated wilderness areas.

Alternative C recommends 91,757 acres of new wilderness. These recommended wilderness areas would add 4 percent (approximately 72,099 acres) of the forest that is moderately or highly departed from its historic fire regime to wilderness management. Like alternative B (modified), constraints placed on the transportation system and the expansion of motor vehicle use and mechanical treatment in recommended wilderness would increase the cost of treatment in these areas. These increased costs would result in fewer acres being treated, which would reduce the ability of the forest to meet resource objectives to restore fire-adapted ecosystems in those recommended wilderness areas. Under alternative C, only 8,363 of those acres represent ERUs where alternative C would have objectives related to mechanical and prescribed fire treatment (Ponderosa Pine, Mixed Conifer with Frequent Fire, and Pinyon Juniper Grassland). See FW-TerrERU-MC-MCFF-O-1, FW-TerrERU-MC-MCFF-O-2, FW-TerrERU-PJ-O-1, FW-TerrERU-PP-O-1, and FW-TerrERU-PP-O-2. Compared to alternative A, reduced treatment on these 8,363 acres would decrease the likelihood of low-level smoke impacts from them in the short term, due to decreased prescribed fire treatments, and increase the likelihood of high-level smoke impacts from them in the long term, due to the increased risk of catastrophic wildfire. Compared to alternative B (modified), reduced treatment on an additional 3,366 acres would decrease the days of low-level smoke impacts from them in the short term, due to decreased prescribed fire treatments, and increase the days of high-level smoke impacts from them in the long term, due to the increased risk of uncharacteristic wildfire.

Alternative C would have 398,006 acres of the forest managed for an unroaded recreation setting compared to alternative A with 276,582 acres and alternative B (modified) with 372,021 acres. Reduced treatment on an additional 121,424 acres, as compared to alternative A, or an additional 25,985 acres, as compared to alternative B (modified), would decrease the days of low-level smoke impacts from those areas in the short term, due to decreased treatments, and increase the days of high-level smoke impacts from them in the long term, due to the increased risk of catastrophic wildfire.

Like alternatives A and B (modified), even if fire treatments do not occur in designated and recommended wilderness areas, or areas managed for unroaded recreation setting, this does not mean there will be lower overall smoke impacts under alternative C. Even if these areas are avoided, it is still assumed that the forest would treat 15,000 to 30,000 acres a year using prescribed fire and 15,000 more acres a year using wildfires managed for resource objectives. The objectives in alternative C could still be achieved through prescribed fire and managing wildfires for resource objectives in other areas of the forest that are moderately or highly departed from their historic fire regime. Because the objectives could still be completed in other areas, the recommended wilderness areas and areas managed for unroaded recreation would not affect the amount of short-term and long-term smoke, only the location from which the smoke would originate. Accordingly, there would still be about the same overall level of short-term smoke impacts from fire treatments, but the smoke impacts would also be associated with treatments or wildfires managed for resource objectives outside of recommended and designated wilderness and areas managed for unroaded recreation. Long-term smoke impacts from fire treatments would be similar to alternative A, but fewer treatment restrictions may lead to fewer uncharacteristic fires, which would result in fewer days with high-level smoke that can exceed air quality thresholds.

Alternative D

Effects for alternative D are the same as for alternative B (modified), with the exception of effects tied to recommended wilderness. Like alternative A, alternative D does not recommend any new wilderness areas. The effects of not recommending any new wilderness areas are the same as for alternative A.

Visibility

Common to All Alternatives

The effects to visibility in designated Class I areas from forest activities are most strongly correlated to smoke impacts. Because of prevailing wind patterns, the Sycamore Canyon and Mazatzal Class I areas would rarely be affected by prescribed fire on the Coconino NF under any alternative. The Grand Canyon, Pine Mountain, and Petrified Forest Class I areas would be impacted less frequently by prescribed fire. Under the Regional Haze State Implementation Plan (ADEQ 2011), ADEQ and the Forest Service assess the risk for smoke hazards to Class I areas before ignition of prescribed fire. Under certain conditions, this would postpone a burn for days or even to the following year until conditions are right to prevent concentrated smoke from entering these areas. In the short term, the protocols and the frequency and rate of prescribed fire activities would not vary by alternative and, therefore, there would be no difference between the alternatives in the number of days with low-level smoke in designated Class I areas from these activities. Consequently, in the long term, there would be no difference between the alternatives in the number of days with high levels of haze due to high-level smoke associated with uncharacteristic wildfires.

Alternative A

Alternative A includes constraints on the use of wildfires managed for resource objectives in wilderness and in wildland-urban interface. Wildfires in wilderness may be allowed to run their natural course if certain prescribed conditions and situations are met. See 1987 Plan, page 112. This plan direction affects over 150,000 acres on the forest that are designated as wilderness. The suppression objective in the wildland-urban interface is 10 acres on wildfires. See 1987 Plan, page 93. Taken together, these factors would result in fewer acres being treated by wildfire managed for resource benefits. Reduced treatments could have a negative impact on native vegetation and communities in wilderness and wildland-urban interfaces that are adapted to a more frequent fire regime.

Not being able to manage wildfires for resource objectives in wilderness and wildland-urban interface would mean fewer days with low level haze present in Class I areas over the short term. However, over the long term, there would be an increased risk for uncharacteristic wildfires because of past fire suppression and the lack of a method for reducing fuel loading. Consequently, the high-level smoke associated with uncharacteristic wildfires would result in more days with high levels of haze, resulting in reduced visibility.

Alternatives B (modified), C, and D

Alternatives B (modified), C, and D manage air quality to meet State and Federal standards (see FW-Air-DC-1, FW-Air-G-1, and FW-Air-Management Approaches) to prevent haze impacts. Accordingly, fire would be able to play a more frequent and natural role in alternatives B (modified), C, and D. This would result in more days with low levels of haze than alternative A in the short term.

Other Forest Activities that Affect Air Quality

Common to All Alternatives

Under all alternatives, the forest anticipates maintaining or increasing the number of acres that are thinned using machinery forestwide. As a result, the emissions of NO_2 from activities, such as thinning, hauling wood, and maintaining, improving or decommissioning roads, would be maintained or would slightly increase if treatments occurred at the higher end of range in vegetation treatment objectives. There would likely be some differences in the location of fire and vegetation treatments based on the differences in land allocations under the different alternatives and, therefore, some local differences in air quality impacts. Under alternative C, there would likely be fewer acres treated mechanically in the Upper Clear Creek watershed, Anderson Mesa, and the Beaver Creek portion of the Red Rock Ranger District compared to the other alternatives because this alternative has more wilderness recommendations and restrictions on where roads can be constructed in those areas. Nonetheless, mechanical treatments and the associated NO_2 and particulate matter impacts would still take place in the Little Colorado River airshed. Alternatives A, B (modified), and D would not vary in how the emissions associated with mechanical treatments would be distributed geographically within the airshed. While there may be some differences in local air quality between the alternatives, the same level of mechanical treatment and the associated emissions is expected at the airshed level under all alternatives.

All alternatives retain the plan direction for campfire restrictions to reduce smoke impacts in Red Rock, Oak Creek Canyon, Sedona Neighborwoods and House Mountain-Lowlands management areas. See MA-RedRock-G-4, MA-OakCrk-S-2, MA-OakCrk-G-11, MA-SedN-S-2, and MA-HouseMtn-G-4. As a result, campfires would not be a major contributor to air quality issues in Oak Creek Canyon. Fire activities and use of fire for heating and debris removal on private inholdings in Oak Creek Canyon could still reduce visibility and increase particulate matter in smoke. Direction to consider the impacts to wildlife is also carried forward in all alternatives. See FW-Fire-G-2, FW-WFP-G-3, FW-WFP-G-8, FW-WFP-G-9, and FW-WFP-G-11. There would be no increase in air quality impacts to these species that would be attributed to the plan direction.

In areas of the forest, where mechanical treatments and prescribed fire would likely be expanded to restore fire-adapted ecosystems, the National Forest System of roads and the traffic on them are likely to increase during the life of these projects. As these projects are completed and roads are closed, decommissioned, or obliterated, the traffic on these roads is likely to return to current levels or lower. Even though these activities contribute to the detachment of fugitive dust, they would be occurring primarily in ponderosa pine and mixed conifer ERUs, which have relatively moister soil conditions and ground cover adequate to mitigate these impacts in the long term.

Fugitive dust from vegetation treatments is not a major concern on the Coconino NF for several reasons. The understory conditions of the vegetation types that dominate and are most likely to be treated (ponderosa pine and mixed conifer frequent fire ERUs) on the Coconino NF do not support long distance transport of dust. These ERUs also have more moisture and protective vegetative ground cover to preserve soil aggregate stability than in pinyon juniper woodland, semi-desert grassland, and desert ERUs. Under all alternatives, to meet the objectives for mechanical treatment, most of the treatments would occur in these two ERUs. Likewise, all alternatives include objectives to mechanically treat between 1,000 and 10,000 acres of Pinyon Juniper with Grass ERUs under all alternatives. Under alternative A, dust abatement would be considered for these treatments through application of best management practices. See 1987 Plan, page 71. Alternatives B (modified), C, and D would also require application of best management practices to these treatments. (See FW-Soil-G-1.) In addition, alternatives B (modified), C, and D include a guideline requiring projects to be

designed to limit long-term impacts to soil function and productivity, such as detrimental soil displacement and erosion, which includes water and wind erosion. (See FW-Soil-G-2.) While alternatives B (modified), C, and D include more express direction related to dust control, all alternatives address the issue and there is not expected to be any difference between the alternatives in fugitive dust transport.

The forest's road system is the most likely contributor to fugitive dust, particularly in the semiarid and arid ERUs, which include the Semi-desert Grassland, Desert Communities, Interior Chaparral, and Pinyon-Juniper ERUs. Of particular concern on the Coconino NF, are the fine sandy loam surfaces of the Supai formation (generally found in the Pinyon Juniper woodland ERUs near Sedona), calcareous soils of the Verde Formation, and calcareous surfaced alluvial soils. Calcareous soils are distinguishable by their white powdery color, high pH and loam or sandy clay loam surface textures. These soils have high or very high wind erodibility, are naturally loose and detached, and are easily transported by wind. Roads on these soil types would have the greatest potential contribution to fugitive dust.

In addition, alternatives B (modified), C, and D include a guideline requiring projects to be designed to limit long-term impacts to soil function and productivity, such as detrimental soil displacement and erosion. (See FW-Soil-G-2.) While alternatives B (modified), C, and D include more express direction related to control of dust, all alternatives address the issue and there is not expected to be any difference among the alternatives.

Common to All Alternatives

Under alternative A, dust abatement would be considered for mechanical treatments through application of best management practices. See 1987 Plan, page 71. Alternatives B (modified), C, and D would also require application of best management practices to these treatments. See FW-Soil-G-1. In addition, alternatives B (modified), C, and D include a guideline requiring projects to be designed to limit long-term impacts to soil function and productivity, such as detrimental soil displacement and erosion, which includes water and wind erosion. See FW-Soil-G-2. While alternatives B (modified), C, and D include more express direction related to control of dust, all alternatives address the issue and there is not expected to be any difference between the alternatives in fugitive dust transport.

Cumulative Effects

Common to All Alternatives

Cumulative effects to fire related to smoke impacts are examined from the standpoint of the sum of the effects of past management activities over the past 10 years on the Coconino NF. Cumulative effects are then explored in the larger spatial context of the forest's vegetation and fire management practices to the surrounding landscape and assessed in 15 and 50 years. The boundary for cumulative effects for air quality is the airsheds that overlap the forests and considers activities that affect those airsheds, regardless of the source. This larger landscape is roughly 20 miles south and west, about 30 miles east and about 100 miles north northeast of the Coconino NF administrative boundary (figure 3).

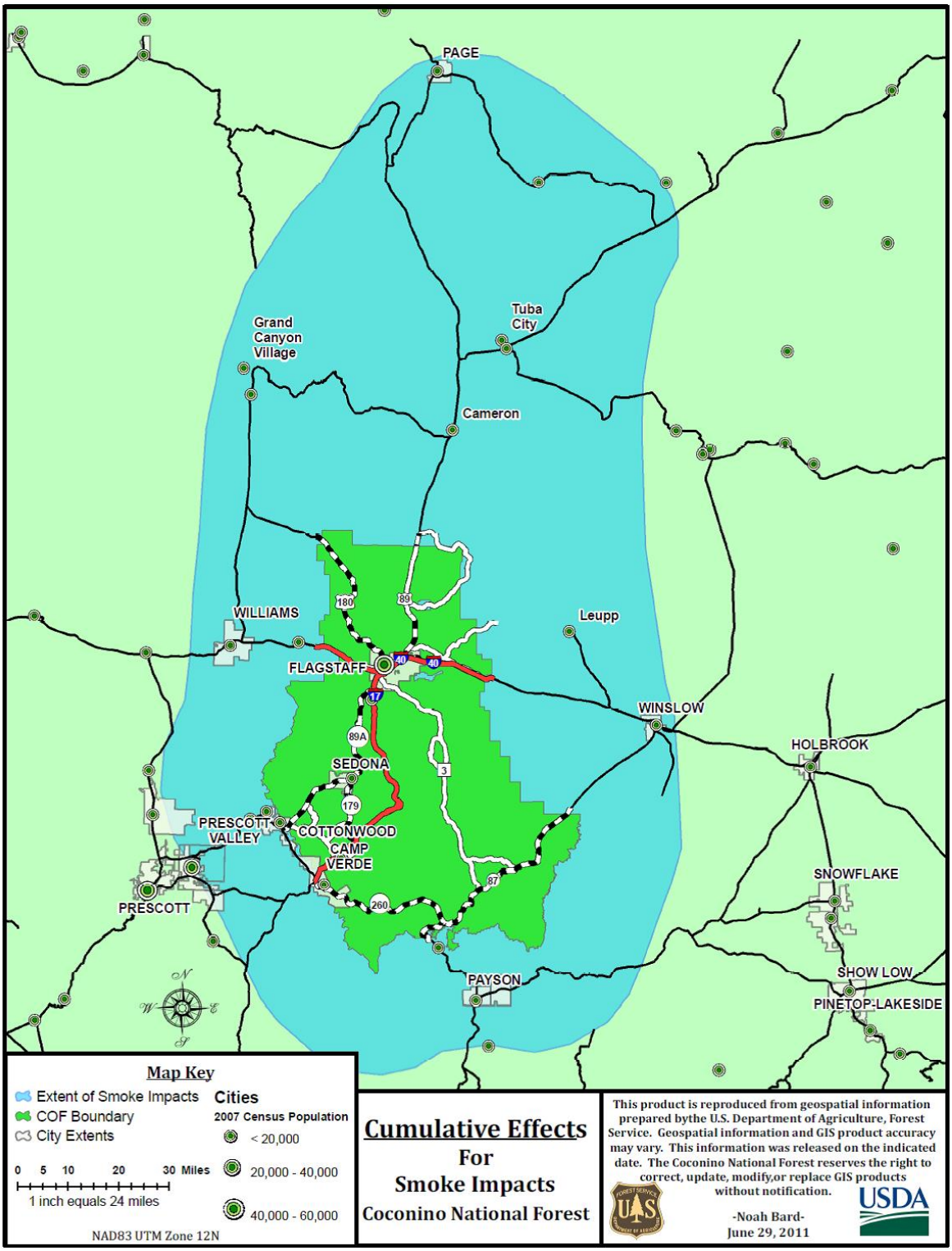


Figure 3. Cumulative effects for smoke impacts

Because smoke impacts are transient in nature, the assessment of cumulative effects is different than other issues and resource areas. For instance, a smoke source can be off-forest, but still impact the Coconino NF. The opposite is also true. Cumulative effects from prescribed fires on Federal, State,

and tribal lands are largely mitigated through implementation of the Enhanced Smoke Management Program in the State Implementation Plan.

Smoke Management

Future smoke from the forest's prescribed fire activities would likely remain within legally acceptable limits with the potential for rare exceptions under all alternatives. This would be due both to the forest fire managers continuing practices that manage smoke and the Arizona Department of Environmental Quality's regulatory efforts.

On a larger scale, State and Federal jurisdictions must follow the same Arizona Department of Environmental Quality regulatory statutes regarding prescribed fire. Therefore, exceedance of air quality standards would likely not occur from prescribed fire. However, all jurisdictions would face challenges of increasing the use of wildland fire treatments while managing smoke impacts.

Smoke from wildfires has more potential (relative to prescribed fire) to exceed State and Federal standards on the Coconino NF and across the larger landscape in 15 and 50 years. This is primarily related to the fact that prescribed fires are burned under specific conditions that have previously been evaluated to lessen or reduce smoke impacts. Prescribed fire also falls under the Arizona Department of Environmental Quality regulation that helps coordinate smoke impacts, which helps avoid impacts to human health. Wildfires, on the other hand, can burn under very extreme conditions that inhibit managers' ability to manage smoke impacts when the emphasis is suppression or managing the fire to protect values-at-risk.

Visibility

Visibility in Class I areas is likely to be impacted to some extent by the cumulative impact of smoke from multiple jurisdictions, but the trend is likely to decrease for particulate matter because of legal requirements and coordination with the Arizona Department of Environmental Quality. Impacts to visibility may occur from concentrations lower than the NAAQS levels meant to protect human health. When prevailing wind conditions are present, fires in southern California may also impact these airsheds. The cumulative risk of high-intensity wildfire throughout southern California and Arizona would be the biggest potential impact to visibility. The frequency and intensity of these fires would have the biggest impact on haze in Class I airsheds. Alternatives B (modified) and D would do the most to lessen the potential for this impact.

The Grand Canyon National Park Class I area is approximately 60 miles northwest of the Coconino NF and is occasionally impacted by smoke from fires on the northern part of the forest. The three main pollutants of concern in the canyon are ozone, particulate matter, and SO_2. The sources of these pollutants in the Grand Canyon are not limited to regional sources within the SMU. Coal-fired power plants in the Four Corners region and industrial and metropolitan sources from California, Nevada, Arizona, and Mexico contribute to the pollution in this airshed because the prevailing winds can transport pollutants over long distances. In addition, wildfire and prescribed fire from other Department of the Interior lands in the area contribute smoke that reduces visibility at the park (National Park Conservation Association 2010).

Other Forest Activities that Affect Air Quality

The release of NO_2 from mechanical treatments on the forest is miniscule compared to what is released from Phoenix, Los Angeles, and freight traffic along the I-40 corridor. Transportation accounts for approximately 50 percent of the emission of NO_2 in the United States (Rodrigue 2011). Approximately 380 million tons of freight is moved out of Los Angeles every year via trucking and one of the four major routes for these goods cuts through the upper third of the Coconino NF (FHWA 2005). Therefore, this freight traffic significantly contributes to NO_2 levels regionally and within the

Coconino NF. In comparison, the impacts from vegetation management on the Coconino NF are not a major contributor of this pollutant regionally. Overall, however, air pollution in airsheds over the forest remains below national standards.

The use of roads on the Coconino NF would be the forest's major contributor to fugitive dust. How much soil is detached and when depends on the activities that would be occurring on the road, the type of vehicle being used, and the road condition. Likewise, dirt roads on private land also contribute to fugitive dust. The biggest industrial contributor is typically construction, especially when a semiarid or arid site is cleared of all vegetation prior to construction. It is probable that migration to the Southwest will continue over the life of the plan and that the areas to the north of Phoenix will continue to be an attractive community, especially for seniors, as services historically have increased proportionally to their population. These demographic changes are likely to continue to drive construction in the analysis area, and it is expected that these activities would have a greater impact on fugitive dust generation. These developments would also increase the demand for improved roads on the forest to access new neighborhoods. This could locally reduce the forest's contribution to fugitive dust.

Cumulative effects of smoke impacts in the Oak Creek Canyon and Sedona Neighborwoods Management Areas largely depend on the contribution of private inholdings. If older wood-burning stoves are updated with more efficient designs and wood-burning fireplaces with propane or natural gas inserts, then the overall smoke impacts are likely to be reduced. The Forest Service contribution has been fairly stable because many sites in the canyon have been converted from overnight camping to day use per Amendment 12 in the 1987 plan. There are now fewer developed sites, and campfires outside of these sites are prohibited. Further reductions are unlikely in available campsites because two remaining campgrounds were recently reconstructed and all alternatives carry forward direction from the 1987 plan to continue the restriction on dispersed campfires.

Watersheds and Water

Affected Environment

Watershed Condition

Watersheds are cataloged using a uniform hierarchical system developed by the U.S. Geological Survey (USGS 2017). The United States is divided and subdivided into successively smaller hydrologic units. The hydrologic units are nested within each other, from the largest to the smallest. This analysis focuses on subbasins (referred to as 4th code watersheds) and smaller watersheds within them (5th and 6th code watersheds).

Watershed condition is the state of the physical and biological characteristics and processes within a watershed that affect the hydrologic and soil functions supporting aquatic ecosystems (Potyondy and Geier 2010).

Watershed condition can range from properly functioning (in a natural pristine state) to impaired (in a severely altered or impaired state). Watersheds in properly functioning condition have terrestrial, riparian, and aquatic ecosystems that capture, store, and release water, sediment, wood, and nutrients within their range of natural variability for these processes. Properly functioning watershed conditions create and sustain terrestrial, riparian, aquatic, and wetland habitats that are capable of supporting diverse populations of native aquatic- and riparian-dependent species. In general, the greater the departure from the natural pristine state, the more impaired the watershed condition is likely to be. Properly functioning watersheds are commonly referred to as healthy watersheds (Potyondy and Geier 2010).

Watershed condition classification is the process of describing watershed condition in terms of discrete categories (or classes) that reflect the level of watershed health or integrity. In our usage, we consider watershed health and integrity to be conceptually the same. Watersheds with high integrity are in an unimpaired condition in which ecosystems show little or no influence from human actions.

The Forest Service Manual (FSM 2521.1) uses three classes to describe watershed condition:

- Class 1 watersheds exhibit high geomorphic, hydrologic, and biotic integrity relative to their natural potential condition and are functioning properly. These are synonymous with Functioning watersheds.
- Class 2 watersheds exhibit moderate geomorphic, hydrologic, and biotic integrity relative to their natural potential condition and are functioning-at-risk. These are synonymous with Functioning-at-Risk watersheds.
- Class 3 watersheds exhibit low geomorphic, hydrologic, and biotic integrity relative to their natural potential condition and are impaired function. These are synonymous with Impaired watersheds

Watershed conditions at the 6th level hydrologic unit code (HUC)[16] have been determined and are appropriate to be used at the planning level. The initial assessment was conducted in February and March 2011, using the national watershed condition framework and assessment tool (Potyondy and others 2011).

The majority of 6th HUC watersheds (65 percent) are in Functional at Risk condition followed by Properly Functioning (19 percent), and Impaired Function (16 percent). Overall, about 81 percent of 6th HUC watersheds are not properly functioning and are departed from reference condition (includes both Functional-at-Risk and Impaired function).

Table 3 details the number of 6th level HUCs within each 4th HUC basin by watershed condition class, and lists the dominant factors that have contributed to degraded watershed condition. Most of the degrading factors are self-explanatory; however, the phrases ‘missed fire return intervals’ and ‘poor aquatic biota and habitat’ need additional clarification. Active fire suppression has reduced the frequency and extent of natural fire and has resulted in missed fire return intervals. Historic livestock grazing practices removed the herbaceous fuels that would have carried natural fire. Collectively these practices resulted in altered composition and structure of vegetation and fuels compared to historic vegetation and fuel conditions. Consequently, the resulting vegetation structure is more vulnerable to uncharacteristic fire which could result in fires of a different size or severity than the vegetation is adapted to; could result in an increase in non-native plant species which could alter hydrologic function or future fire return intervals; and could result in accelerated erosion and sedimentation into connected waters. In this discussion, uncharacteristic wildfires are wildfires with characteristics other than what ERUs are adapted to e.g. larger, more intense, more severe, bigger patch sizes, or more frequent than what occurred historically. Wildfires could also spread into areas where specific or exceptional circumstances need to be present in order for wildfire to occur such as Alpine Tundra, drought in riparian areas, or Spruce-fir (where large high severity fires naturally occur but are infrequent). Poor aquatic biota and habitat means that non-native aquatic species now occur within native aquatic species habitat in which non-natives were assumed absent historically.

[16] The United States is divided and sub-divided into successively smaller hydrologic units which are classified into six levels: regions, sub-regions, accounting units, cataloging units or sub-basins, watersheds and subwatersheds. The hydrologic units are arranged within each other, from the smallest (subwatersheds) to the largest (regions). Each hydrologic unit is identified by a unique hydrologic unit code (HUC) consisting of two to twelve digits based on the six levels of classification in the hydrologic unit system.

Consequently, the abundance and distribution of native species have declined in response to non-native species or habitat modifications such as a dam.

Note that the Havasu Creek and Tonto Creek 4th code watersheds have low acreage on the forest, and thus, have only one 6th code watershed each compared to 15 or more for the other 4th code watersheds.

Table 3. Summary of watershed condition for 6th code watersheds (number in each condition class)

4th Code Watershed	Number of 6th Code Watersheds	Class 1: Functioning Properly	Class 2: Functioning-at-Risk	Class 3: Impaired	Common Degrading Factors
Canyon Diablo	26	2	20	4	High road density, missed fire return intervals, water quality impaired or not-attaining, functional-at-risk wetland conditions, well pumping
Havasu Creek	1	0	0	1	Very low acreage in forest. Impaired soil conditions.
Lower Little Colorado River	16	7	8	1	Impaired soil conditions, missed fire return intervals, high road density
Lower Verde River	22	1	18	3	Impaired and unsatisfactory soil conditions, missed fire return intervals, poor fire regime conditions
Middle Little Colorado River	15	5	9	1	High road density and close proximity to streamcourses, missed fire return intervals, impaired and unsatisfactory soil conditions, functioning-at-risk riparian conditions, poor aquatic biota and habitat conditions
Upper Verde River	39	8	22	9	Unsatisfactory soil and riparian conditions, impaired or not-attaining water quality, missed fire return intervals, high road density and in close proximity to streams, poor aquatic biota and habitat conditions, well pumping
Tonto Creek	1	0	1	0	Very low acreage in forest. Impaired soil and riparian conditions.
Total	**120**	**23**	**78**	**19**	

Many of the impaired watersheds are found around communities including Flagstaff, Sedona, and Camp Verde. The ratings given to these watersheds reflect the effects of development, such as added runoff from high density of roads, high recreation impacts to riparian area, aquatic biota and habitat, high well withdrawals of groundwater, and increased sources of water pollution as compared to undeveloped land. Functional-at-risk watersheds dominate the forest and are the result of human impacts that have reduced soil and riparian and aquatic condition. High road densities redirect water from natural flow paths. High occurrence of stock tanks interrupt flows by detaining water and can reduce flow to downstream segments. The majority of functional watersheds are located in

wilderness areas relatively free of human development and impacts or in Great Basin Grassland ERUs where roads and streams are scarce.

Groundwater

Three major groundwater basins originate on the forest: the Little Colorado River Plateau, the Verde River, and Coconino Plateau basins. The forest lies mainly in the Verde River and Little Colorado River Plateau basins. Areas of highest precipitation and groundwater recharge for these basins occur on Coconino NF lands.

Major uses of groundwater in the Little Colorado River Plateau basin are: agriculture, municipal use, power generation, and paper manufacturing. Groundwater and surface water are used for the City of Flagstaff‘s domestic water supply.

Major groundwater uses in the Verde River and Coconino Plateau basins are: agriculture and municipal use. Verde Valley cities rely mostly on groundwater through permitted wells in the Verde River basin.

Major uses of groundwater within the forest in all basins include domestic water supply for forest campgrounds, day-use areas and administrative sites, and to a lesser extent, livestock and wildlife consumption.

Even though reference conditions are largely unknown, it is assumed that the natural discharge/recharge in all three basins were in a steady state since there was less domestic use than today. Groundwater pumping was minimal before the 20th century (City of Flagstaff 2012).

Demand is predicted to exceed supply in the Little Colorado River Plateau and Verde River Basins (BOR 2006). In preparation, the City of Flagstaff purchased water rights at the Red Gap Ranch east of the City as a potential source of groundwater and to diversify the City’s public water supply resources (City of Flagstaff 2015).

Groundwater extraction is expected to increase on non-forest lands due to well pumping for private and public domestic uses and for agricultural purposes and remain static on forest lands because minimal groundwater extraction occurs (Wolfe 2011). Continued or increased groundwater extraction may negatively affect the base flow of streams, especially the Verde River, Beaver Creek, West Clear Creek and Oak Creek, because domestic use is high in areas adjacent to these streams. Groundwater pumping within the Little Colorado River Plateau may negatively affect wells on NFS land that are used for stock watering and domestic use. Groundwater extraction in the Verde Valley sub-basin has increased exponentially during over the last 50 years. A growing awareness of sustainable water management recognizes that development of groundwater affects connected surface water. With increasing population and water use, sustainability of water resources and long-term health of the Verde River are of concern (Leake and Haney 2011, Leake and Pool 2010). Groundwater pumping adjacent to springs and seeps may reduce flow, but little quantitative information is available to accurately project the extent. The downward trend in groundwater levels is projected to continue with increasing use adjacent to the Verde River and Flagstaff; however, trends in the remainder of the area are unknown. There is an opportunity to contribute to sustainability of groundwater since it is located in several aquifers that are well distributed and represented throughout the forest.

Because the vast majority of well withdrawals occur off-forest, they are not within the forest’s authority to control. Forest Service regional and national groundwater policy (Forest Service Manuals 2560, 2880, 2540, and 2543). provide direction for groundwater management on the forest

and specify that these activities are not to adversely affect connected riparian habitat and water quantity and quality. Because regional and national groundwater policy was considered to be adequate, additional guidance related to groundwater is not provided under any alternative and, therefore, not analyzed in this environmental impact statement.

Water Quantity and Quality

This section describes water bodies that have surface water at some time of the year or year round. Surface water includes perennial, intermittent, and ephemeral streams, reservoirs, lakes, wetlands, stock ponds, and seeps and springs.

Many plant and animal species rely on perennial stream water for survival. The Homestead Act of 1862 (P.L. 37-64) facilitated the transfer of some lands containing streams into private ownership, and the creation of dams on East Clear Creek and Leonard Canyon formed CC Cragin Reservoir and Knoll Lake, respectively. Diversions and irrigation ditches reduce streamflow along some stream segments and have been operational for many years. Most diversions and ditches are located off-forest.

Based on recent GIS calculations, there are approximately 5,927 miles of stream course within the administrative forest boundary, which includes lands not managed by the forest. About 4,976 miles of these stream courses are on lands managed by the forest. For perennial stream courses (flow year-round), there are approximately 400 miles within the administrative forest boundary and 272 miles on National Forest System. For intermittent stream courses (flow seasonally), there are about 1,108 miles within the administrative forest boundary and 939 miles on lands managed by the forest within the administrative boundary. For ephemeral stream courses (flow only briefly in response to storm events), there are approximately 4,419 miles within the administrative forest boundary and 3,766 miles on lands managed by the forest within the administrative boundary.

Forest water yield is predicted by comparing gauged streamflow data. forestwide water yield in 1980 was estimated to be about 1,915 acre feet per year (USDA Forest Service 1987a). Based on USGS streamflow gauge data, water yield may be similar to or slightly less today.

Output of water yield or water supply (used synonymously in this analysis) is the amount of water which leaves the immediate site to become surface water yield or groundwater recharge. Essentially, it is the difference between total precipitation and actual evapotranspiration.

A comparison of actual USGS gauged streamflow from major, perennial streams from about 1985 to 2005 was used to estimate streamflow water yield trend. Streamflow water yield is calculated for those streams where USGS has gauged data over the last 20 years or more. Analysis of streamflow trend is useful to determine if major changes in water yield has occurred for that given stream. Table 4 summarizes trends in streamflow by 4th level HUC watershed (subbasin) from 1985 to 2005. Data were derived from USGS stream gauges (USGS 2017). Flow has been similar from 2005 to 2015, resulting in a trend similar to 1985 to 2005.

Table 4. Streamflow trend by watershed

Forest Stream	Watershed (4th HUC)	Trend 1985 – December 2005
West Clear Creek	Lower Verde	Static to Slightly Downward
Fossil Creek	Lower Verde	Upward from decommissioning.
Wet Beaver Creek	Upper Verde	Slightly Downward
Dry Beaver Creek	Upper Verde	Static to Slightly Downward

Forest Stream	Watershed (4th HUC)	Trend 1985 – December 2005
Verde River Near Clarkdale	Upper Verde	Slightly Downward
Verde River Near Camp Verde	Upper Verde	Static
Oak Creek at Sedona	Upper Verde	Slightly Upward
Oak Creek Near Cornville	Upper Verde	Static to Slightly Upward
East Clear Creek	Lower Little Colorado River	Not gauged on forest portion

*Full flow to Fossil Creek was returned following Irving power plant decommissioning activities in 2006. Streamflow is currently measured to be about a constant 43 cubic feet per second and much more than prior to diversions (USGS 2017). Therefore, streamflow trend is upward compared to prior to decommissioning and static since decommissioning.

All data were compiled on the forest and may not represent overall watershed yield because it does not include the Little Colorado River sub basin, in particular, East Clear Creek. East Clear Creek is not gauged in the forest portion, so no data is available for that trend.

Reference levels of water yield are unknown; however, research suggests that water yield in pre-settlement, open-canopied ponderosa pine forests was higher than in the closed-canopy forests that are prevalent today (Brown et al. 1974 in USDA Forest Service 2009c). Studies in paired watersheds (watersheds that are similar in nature with regard to their vegetation and soils) in Arizona have shown that there was a short-term (1 to 3 years) increase in water yield following thinning in ponderosa pine forests (Brown et al 1974). Currently, treatments with the specific objective of increasing water yield are not being considered on the forest, and therefore, additional research on water yield has not been done.

Current surface water use on the forest is slightly higher than in the early 1980s, because new campgrounds and day-use areas were created in response to increased recreation use. It is estimated that overall forest water yield is **static to slightly downward** over the last 20 years due to analysis of streamflow water yield and the following two conditions. Greater tree and shrub basal area and canopy cover has occurred (USDA Forest Service 2016c) and been observed (R. Steinke, 1989 to 2015) in several ERUs and recorded over the last 25 years, which probably results in increased evapotranspiration and decreased runoff and water yield (USDA Forest Service 2004c).

Drought conditions are common throughout the Southwest Region, and have likely contributed to decreased precipitation, runoff, and water yield from streams on the Coconino National Forest (USDA 2010). Climatic (or drought) and vegetative conditions on the Little Colorado River watersheds are similar to the Verde River watersheds and, therefore, water yield trend is estimated to be similar (static to slightly downward).

Streamflow trend in specific streams is variable. In the Lower Verde 4th level HUC watershed, the trend for West Clear Creek is static to slightly downward whereas the trend for Fossil Creek is upward due to decommissioning of the Irving Power Plant. In the Upper Verde 4th code watershed, the trends for Wet Beaver Creek and the Verde River near Clarkdale is slightly downward; the Verde River near Camp Verde is static; Dry Beaver Creek is static to slightly downward whereas Oak Creek near Cornville is static to slightly upward, and Oak Creek at Sedona is slightly upward. There is no gauge on East Clear Creek, so trend information is unavailable. These streams currently support, or have historically supported, native fish populations. Where downward trends in streamflow persist or accelerate, habitat for aquatic organisms is expected to decrease or become significantly degraded (Steinke 2016, Haney et al. 2008).

Water quality has been assessed in major perennial stream reaches and lakes on the forest (ADEQ 2017). The general classifications used for surface water quality by Arizona Department of Environmental Quality (ADEQ) are attaining, attaining some uses, inconclusive/not assessed, not-attaining, and impaired for the identified uses. Designated beneficial uses are either aquatic and warm water fisheries, full body contact (swimming) or fish consumption. The classification designates each waterbody in one of five categories:

- **Category 1** – Surface waters assessed as "attaining all uses." All designated uses are assessed as "attaining."
- **Category 2** – Surface waters assessed as "attaining some uses." Each designated use is assessed as either "attaining," "inconclusive," or "threatened."
- **Category 3** – Surface waters assessed as "inconclusive." All designated uses are assessed as "inconclusive" due to insufficient data to assess any designated use (such as insufficient samples or core parameters). By default, this category would include waters that were "not assessed" for similar reasons.
- **Category 4** – Surface waters assessed as "not attaining." At least one designated use was assessed as "not attaining" and no uses were assessed as "impaired." A total maximum daily load[17] (TMDL) analysis will not be required at this time for one of the following reasons:
    - **4 A. -** A TMDL has already been completed and approved by the EPA, but the water quality standards are not yet attained;
    - **4 B. -** Other pollution control requirements are reasonably expected to result in the attainment of water quality standards by the next regularly scheduled listing cycle; or
    - **4 C. -** The impairment is not related to a "pollutant" loading, but rather due to "pollution" (such as hydrologic modification).
- **Category 5** – Surface waters assessed as "impaired." At least one designated use was assessed as "impaired" by a pollutant. These waters must be prioritized for TMDL development.

Water quality is assessed by comparing existing conditions (categories 1 to 5) with desired conditions that are set by the states under authority of the Clean Water Act. Waters that are not listed as not-attaining are providing for beneficial uses identified for that stream and can be considered in a desired condition until further sampling indicates impairment. Those in category 2 or higher require special attention during site-specific project analysis. The ADEQ is the regulating authority for water quality in Arizona as promulgated by the EPA.

The ADEQ also interprets its surface water quality standards to apply to "intermittent, non-navigable tributaries." The ADEQ interprets the definition of "surface water" to include tributaries ("the tributary rule") and assigns water quality standards to intermittent surface waters that are not specifically listed by name in Arizona's surface water quality standards rules. The ADEQ feels it is necessary to regulate and protect these types of waters as "waters of the United States" because it is estimated that approximately 95 percent of the surface waters in Arizona are either intermittent or ephemeral.

[17]A TMDL is a written analysis that determines the maximum amount of a pollutant that a surface water can assimilate (the "load"), and still attain water quality standards during all conditions. The TMDL allocates the loading capacity of the surface water to point sources and nonpoint sources identified in the watershed, accounting for natural background levels and seasonal variation, with an allocation set aside as a margin of safety.

Based on these State water quality categories, any stream listed as Category 5 or Category 4 is considered highly departed from reference conditions. Nonlisted streams, or streams in Categories 1 through 3, were identified as not impaired and are considered to meet the desired condition.

Reference water quality was assumed to be sufficient to sustain ecological systems and species and be of equivalent quality as attaining all uses as intended by Arizona State water quality standards. Nonpoint sources of pollution such as roads, timber harvesting, livestock overgrazing, recreation, and uncharacteristic fire were neither widespread nor frequent.

Water quality of Coconino NF's lakes and streams is variable. There are 189 miles in Category 1, 2, or 3 streams on the forest. About 33 miles (about 15 percent) of streams (50 miles including non-forest lands), five reservoir lakes, and one natural lake on the forest are classified as Category 4a by ADEQ. The ADEQ suggests potential treatments to focus on not-attaining waters and their contributing watersheds. The forest has the following five approved TMDLs designed by ADEQ in response to past water quality impairments: Verde River for turbidity; Stoneman Lake for dissolved oxygen, pH, and nutrients; Oak Creek at Slide Rock for pathogen *Escherichia coli* (*E. coli*); Oak Creek Basin including Munds Creek for nitrogen and phosphorus; and Lake Mary Regional TMDL for mercury in fish tissue. The Lake Mary Regional TMDL incorporates all water bodies identified as not attaining for mercury in fish tissue. These TMDLs strive to improve water quality through recommended appropriate management activities by the forest and State agencies. Water quality is described below by watershed.

Canyon Diablo fourth code watershed: Two reservoir lakes within the Walnut Creek fifth code watershed—Upper Lake Mary and Lower Lake Mary—are identified as not-attaining due to elevated mercury levels in fish tissue. The Lake Mary Regional TMDL for Mercury in Fish Tissue was developed to address this impairment. The TMDL concludes the majority of the mercury is derived from atmospheric deposition with some mercury originating from natural geologic materials. Mercury readily binds to soil particles and organic matter and can therefore be transported to surface waters through erosion and runoff processes. Once in a water body, mercury can remain suspended with sediments in the water column for long periods of time, contributing to fish uptake.

The TMDL states that watershed loading can potentially be reduced through prevention of erosion and sediment delivery and promoting vegetative stability. This infers that limiting activities that cause high levels of soil disturbance and loss of protective vegetative ground cover should be minimized and mitigated to the greatest extent possible.

Middle Little Colorado River fourth code watershed: Three reservoir lakes in the Jacks Canyon fifth code watershed—Long Lake, Soldier, and Soldier Annex—are also identified as not-attaining due to elevated mercury levels in fish tissue. These reservoirs are included in the Lake Mary Regional TMDL for Mercury in Fish Tissue. Recommendations for limiting loading of mercury in these reservoirs are the same as those provided for Upper Lake Mary and Lower Lake Mary.

Upper Verde fourth code watershed: About 65 percent of the not-attaining stream miles in the Oak Creek fifth code watershed occur on forest lands. Oak Creek and Spring Creek are not-attaining due to the presence of *E. coli* bacteria, which is attributed to the proximity of privately owned septic systems in certain reaches, introduction of *E. coli* by wildlife, improper sanitary habits of swimmers and disturbance of in-stream sediments. This may represent a public health concern if people come in contact with the water that is exceeding the *E. coli* bacteria criterion. Health alerts are managed by the County Health department. Although a TMDL is approved and is being implemented, ADEQ monitoring indicates that in some years, water quality in Oak Creek still remains not-attaining during summer months with high recreational use and swimming. Oak Creek was previously listed as not

attaining water quality standards for turbidity although the TMDL focuses on exceedances of pathogens. Past exceedances in turbidity in Oak Creek indicate a need to better manage the watershed and road network to reduce the amount of sediment delivered to Oak Creek and support designated beneficial uses. In addition, pathogens can be transmitted through adjacent sediment delivered to Oak Creek and can perturbate the pathogens already lodged in the creek sediment. Therefore, management that strives to control nonpoint source pollution (sediment delivery) is an essential part of the TMDL recommendations for forest management.

In the Beaver Creek fifth code watershed, Stoneman Lake is rated as a Category 4 primarily due to high nutrients, high pH, and low dissolved oxygen impacted by local residential development including septic systems in the same watershed. These exceedances have been present for several years. Stoneman Lake is relatively shallow (less than 3.5 meters), has no surface outlet, and is designated as a cold-water fishery. The lake has historically experienced an abundant growth of submerged aquatic vegetation (SAV) during the warm weather months, with resulting vertical stratification and hypoxia in the lower water column (ADEQ 2017). About 60 percent of the lake is on NFS land and the other 40 percent is privately owned. An increase in nutrients can result in rapid growth of algae and other plants in the lake, which may result in a drop in dissolved oxygen that can be devastating to other aquatic life and sometimes leads to fish kills. A TMDL has been approved, but has not yet been implemented. Currently, the lake is fenced from livestock.

In the Cherry Creek-Upper Verde River fifth code watershed, 29 stream miles in the Verde River are in Category 4, primarily due to exceedances in turbidity and nutrients, which affect warm water fisheries. Turbidity is considered non-point source pollution and is likely coming from accelerated erosion and sediment delivery from the road network and adjacent hillslopes. Other threats identified in the Verde River TMDL for Turbidity include previous and ongoing mining operations, sand and gravel extraction, agricultural diversions, livestock grazing, urban development and associated contamination, over-use for recreational purposes, and surface water impoundments (ADEQ 2001). A TMDL has been approved for this and the Lower Verde section (described below) and is being implemented. Implementation of the Travel Management Rule is expected to reduce sediment delivered from the current road network over the next several years (Steinke 2016, USDA Forest Service 2011e). Recommendations in the Verde River TMDL include road maintenance, decommissioning or obliteration to reduce sediment delivery into connected streams, improved grazing strategies and practices, and watershed improvements on both uplands and riparian areas. TMDLs for Stoneman Lake, Oak Creek, and Munds Creek don’t include specific recommendations for off-highway vehicle management or road obliteration but implementation of the Travel Management Rule is expected to reduce sediment delivered from the current road network over the next several years.

The Fossil Creek-Lower Verde River fifth code watershed includes 21 miles along the Verde River that are assessed as Category 4 for turbidity. About 15.5 miles in this stretch are a shared boundary with the Prescott NF, and the remainder is privately owned. Exceedances in turbidity affect warm water fisheries with the source likely coming from the road network and adjacent hillslope disturbances. Recommendations in the Verde River TMDL include limiting or restricting off-highway vehicle travel and decommissioning or obliteration of roads to reduce sediment delivery into connected streams. Nonpoint source pollution into connected streams may continue to increase over the next 3 to 5 years. However, a Comprehensive River Management Plan (CRMP) is being developed to improve management of the free-flowing natural character of the creek and its unique and outstanding values. This CRMP will provide detailed direction, management expectations, and monitoring requirements that will improve overall management of Fossil Creek. Recreational access to Fossil Creek is now more restricted and controlled through a permit process, which is reducing

disturbance that otherwise contributes to increased stream sediment and *E. coli* levels. Sanitary facilities have been installed (i.e., vault toilet). While the current trend remains away from desired condition, improved management of Fossil Creek under the CRMP is expected to result in a trend of toward desired condition. A desired condition for Fossil Creek is for turbidity to be low except during flood events, and *E. coli* levels to be low. (SA-Wild-Fossil-DC)

The remaining stream miles on the forest are classified as Categories 1 through 3 and are attaining some or all uses, or monitoring data are inconclusive.

On the Coconino NF, the most important nonpoint sources of pollution are from sediment generated from roads near drainages. The forest currently implements and monitors site-specific best management practices for all activities with the potential to pollute Arizona's waters. These best management practices include: water quality monitoring, implementation of TMDL report recommendations,[18] implementation and monitoring of best management practices for all projects that have the potential to increase nonpoint pollution, and State certification and mitigation of temporary point source pollution through the Clean Water Act's National Pollution Discharge Elimination System regulations. Wastewater treatment sites associated with campgrounds and administrative sites are the only potential point sources of water pollution the forest manages at this time.

Summary

Water quality trends are static for not-attaining streams and downward, in recreation-impacted perennial streams with high amounts of recreation like Fossil Creek. The forest is working closely with the ADEQ in planning and implementing TMDL plans. Water quality trends are static to upward in the Grindstone Wash-Upper Verde River, Beaver Creek, Cherry Creek-Upper Verde River, and Fossil Creek-Lower Verde River (slightly upward trend) 5th code watersheds except in those lakes or stream portions classified as Category 4. Static to downward water quality trends occur in the Jack's Canyon, Walnut Creek, and Oak Creek 5th code watersheds, primarily due to the lakes and stream portions classified as Category 4.

Water Rights

Surface water is procured and used for livestock watering, wildlife including fish, domestic use, irrigation, fish consumption, and swimming. Under Federal reserved water rights,[19] surface water is also available for administrative use, such as firefighting and road maintenance.

The forest is currently active in procuring instream flow water rights for all major perennial streams. All current instream flow applications have been approved by the Arizona Department of Water Resources and assessments are almost completed, pending protest resolution by the Salt River Project and other private parties. The following streams have certified instream flow water rights, and therefore, risks of diversion from streams from non-forest parties are minimized; Fossil Creek (shared with Tonto National Forest), Verde River, Wet Beaver Creek, West Clear Creek, Sycamore Creek, Walker Creek and Spring Creek. And, Red Tank Draw and Sheepshead Creek are pending final approval by Arizona Department of Water Resources.

The following forest streams have instream flow applications that have been approved and assessments pending Arizona Department of Water Resources water right certification: East Clear Creek, Oak Creek, Red Tank Draw, and Sheepshead Creek. It is expected that Arizona Department

[18] More information may be found at the following website: http://azdeq.gov/environ/water/assessment/assess.html
[19] Federal reserved water rights associated with public lands are reserved to satisfy the purposes for which the public land was established. These water rights, however, are subject to court adjudication.

of Water Resources will award Certified Water Rights for all perennial streams following protest resolution.

Environmental Consequences

Alternatives are compared based on their ability to move the water resources (i.e., water quality, water quantity, and watershed condition) toward desired conditions.

Common to All Alternatives

All alternatives have language to meet Arizona water quality standards (1987 Plan, page 28, FW-Water-DC-7 and G-5).

Under all alternatives for ground-disturbing activities including trail maintenance, temporary road construction, and trail construction, implementation of best management practices (FSH 2509.25 and 2509.22) per plan guidelines would be effective in reducing sediment and improving water quality and overall watershed conditions ((1987 Plan, page 71 and FW-Water-G-4). Improving water quality would provide higher quality, more resilient habitat for aquatic organisms. Where surface waters serve as public water supplies (e.g., Upper Lake Mary, Verde River, and C.C. Cragin Reservoir), water quality would be improved, thereby reducing the cost of treatment.

Alternative A includes direction for the protection of riparian areas through the use of filter strips (1987 Plan, pages 71 to 72). Alternatives B (modified), C, and D also include guidelines to use aquatic management zones for riparian areas (FW-Rip-All-G-3), non-riparian intermittent streamcourses (FW-Rip-Strm-G-2), and reservoirs (FW-ConstWat-G-1) depending on site-specific conditions protecting water quality and the functioning of riparian forests. These guidelines recommend the width of the aquatic management zone based on the erosion hazard (severe, moderate, or slight) in the area. A guideline for roads (FW-RdsFac-G-5) recommend that permanent and temporary road construction and relocation should occur outside of streamcourses and aquatic management zones, except where crossing is required; avoid wetlands, springs, seasonally wet meadows, and montane meadows; and avoid soils that are unstable and highly erodible where connected to streamcourses.

Whether projects use filter strips or aquatic management zones, the results should be similar; permanent damage to perennial plants would not occur, which would result in the maintenance of soil cover, reduced sheet erosion, and improved nutrient cycling and soil productivity. The aquatic management zones would be designed to reduce sedimentation, maintain channel function within floodplains, and maintain downstream water quality and riparian habitat and function. The aquatic management zones would also avoid detrimental changes in water temperature or chemical composition, blockages of streamcourses, and sediment deposits that could seriously and adversely affect water conditions, fish habitat, or connected downstream cave, karst, and lava tube resources.

Alternative A would have the same number of acres thinned and burned in ponderosa pine, as alternatives B (modified), C, and D. At the low end of ponderosa pine treatment in these alternatives, there would be about a 4 percent decline in the percentage of open states (0 to 30 percent canopy closure) at year 15 under the low end of the range of treatment, compared to existing, and by year 50, there would be about a 1 percent decline in the percentage of open states compared to existing. By year 50, open states would have a slight positive trend toward desired distribution of open states. However, the extent of treatment under the low end of the range of objectives would probably slightly lower water yield and do little to reduce the threat of uncharacteristic fire. Water yield would be projected to increase at the high end of treatments in both the short and long term providing

treatments are maintained over time , and threat of uncharacteristic fire would be expected to decrease.

Instream flow water rights would be maintained and procured at similar levels under all alternatives (1987 Plan, pages 74 and 206 and FW-Water-G-3). Procurement of instream flow water rights would improve the extent of uninterrupted streamflows across NFS lands, thereby, providing greater aquatic habitat continuity and resilience since outside parties would not be able to secure water rights on these streams for purposes other than wildlife habitat.

The effects of plan language regarding special uses on watershed health would be the same in all alternatives. Impacts to watershed condition can occur from group events, powerline and water transmission corridors and access roads, mineral extraction, fuelwood gathering, and cultural or religious uses. These effects include accelerated soil erosion, sediment delivery, adverse effects to surface water quality, impacts to stream morphology, and degradation of aquatic habitats. Site-specific best management practices would be required under all alternatives and would be effective in mitigating adverse effects to soils and water quality components of watershed condition.

Alternative A

Watershed Condition

Watershed condition is expected to remain similar to current condition and the trend is expected to remain static under implementation of the current plan.

Alternative A does not contain specific desired conditions for watershed condition. It emphasizes watershed condition in a general sense by management area. Alternative A has management emphasis statements that use outdated, language and does not focus on soil and riparian function or overall watershed condition. Instead, it has management goals to have all soils in satisfactory soil condition by 2020, and 80 percent of riparian recovery by 2030. Under current and past rates of plan implementation, these goals have not been achieved under current budgets and, therefore, watershed condition has not improved as rapidly as in the other alternatives

The lack of plan direction specific to 6th HUC watersheds would result only in site-specific water resource improvement and would be less likely to improve overall watershed condition, including associated water quality, riparian, and soil function. The current plan simply states “maintain or enhance watershed condition and plan projects where conditions are unsatisfactory” (see pages 23 and 72 in the 1987 plan) with no specific guidance (desired conditions, guidelines and objectives) on mitigating the limiting factors outlined in a table except road obliteration (1987 Plan, page 75). The current plan does not guide improvement of watersheds that are functional at risk, where action alternatives do. The current plan does provide guidance to focus on Lake Mary and Oak Creek watersheds for water quality reasons (1987 Plan, page 206-72) similar to the action alternatives in the context of priority watersheds.

The current plan does not contain any plan objectives to implement treatments designed to move watersheds toward proper functioning condition (PFC). The lack of plan objectives and direction to move watersheds to PFC would continue to result in fewer planned and implemented treatments, resulting in less focus on and less improvement of water quality, riparian, soil, and watershed function than would occur under the other alternatives.

Alternative A lacks specific guidance to implement ADEQ TMDL recommendations; therefore, water quality improvement projects would only occur on an opportunity basis; be less likely to be implemented than if there were explicit plan direction; and would more likely result in a static trend in water quality.

However, alternative A has several standards and guidelines related to protecting water resources including: procurement of instream flow water rights on an opportunity basis; protection of riparian areas though filter strips; and maintaining 80 percent crown cover, 80 percent emergent vegetation cover, and three age classes of woody riparian species (see page 174 in the current plan). The guidance provided in alternative A for water resources, however, is lacking in a number of aspects:

- Due to lack and vagueness of current plan guidance, impaired or unsatisfactory soil condition and not attaining or functional-at-risk riparian function are less likely to be improved as quickly as alternatives B (modified), C, and D. Hazardous fuels posing a threat to soil condition and water quality are less likely to be reduced as quickly as in alternatives B (modified), C, and D. Treatments that result in functional riparian and springs condition that provide for streamflow and improve water quality, quantity, and timing of flows would only occur on an opportunity basis (1987 Plan, pages 169, 23) and would move more slowly toward desired conditions compared to alternatives B (modified), C, and D.

Due to these gaps in plan direction, continuing implementation of alternative A would not improve impaired water quality; maintain instream flows and riparian habitats, soil, and watershed functions; and would not move watershed resources toward desired conditions as quickly as alternatives B (modified), C, and D. This is primarily due to the lack of emphasis in priority watershed identification and restoration.

Groundwater

Alternative A plan language lacks guidance on protecting and maintaining groundwater quality and aquifer levels, but do provided focus on keeping an inventory of groundwater and evaluating management practices (1987 Plan, page 73).Substantial groundwater drawdown has occurred on non-NFS land due to excessive well pumping, but are outside the control and authority of the forest. Consequently, the trend for groundwater is away from desired conditions on non-forest administered lands and static on forest lands for alternative A.

Water Quantity and Quality

The increased risk of uncharacteristic fire in fire-adapted ERUs results from past fire exclusion that allowed ERU conditions to become more dense and more prone to fires that can ascend into the tree canopy, rather than predominantly remain in the understory. Uncharacteristic fires can result in high burn severity; accelerated erosion and excessive sedimentation to connected streamcourses, excessive or increased water flow, and uncharacteristic flooding; and degraded water quality.

Thinning and prescribed fire treatments can reduce forest density, which in turn, reduces the amount of water used by trees. This allows more water to infiltrate soils and contribute to groundwater recharge, increasing the potential for greater spring discharge from perched aquifers. Reduced water demand by trees can also contribute to increased runoff into streams and downstream riparian forests, and to recharge of deep aquifers. Thinning can also increase open spaces where snow accumulates and melts rather than being intercepted by tree canopies where a large fraction evaporates (O'Donnell 2014). Opening up the canopy through thinning treatments would be expected to increase water yield from treated watersheds for a 6- to 10-year period, but runoff and infiltration would likely return to pre-treatment levels where water demand of herbaceous vegetation offsets water demand of trees (Springer et al. 2006). Forest thinning can create conditions more conducive to desired fire effects for soils, surface water quality, water quantity, and watershed condition. However, if forest thinning and fire treatments are not maintained, water yield and infiltration rates would likely return to pretreatment levels within 10 years.

In Pinyon Juniper with Grass ERU, under alternative A, there would be a net improvement in the percentage of open states (0 to 30 percent canopy cover) by year 15 with the implementation of anticipated treatments. This would result in increased water yield and groundwater recharge in the short term and a reduction in the threat of uncharacteristic fire. Without an increase in treatments, however, modeling suggests that at year 50, treatments at the projected level would be unable to maintain the desired open conditions because canopy cover and competition would increase. Consequently, water yield would likely decline, and the threat of uncharacteristic fire would increase.

In Mixed Conifer with Frequent Fire, under alternative A, the percentage of open states would nearly triple by year 15 (compared to existing conditions) with the implementation of anticipated treatments. This would result in improved water yield in the short term and a reduction in the threat of uncharacteristic fire.

Overall, the forestwide trend for water quality for alternative A is static, but some streams are projected to move away from desired conditions of meeting EPA and ADEQ water quality standards for designated uses.

Alternative A has forestwide standards and guidelines that intend to comply with P.L. 92-500 Federal Water Pollution Control Act and Arizona water quality standards through implementation of best management practices; through implementing projects that are cost-effective and/or are beneficial for maintaining and improving water quality. There are other forestwide standards and guidelines to conduct monitoring where needed to assure compliance with the Arizona water quality standards and P.L. 92-500 (1987 Plan, pages 71, 73, and 190); conduct water quality monitoring of primary contact recreation sites to standards of Forest Service Manual 2540 and Arizona water quality standards for full body contact waters (swimming and wading); and to conduct monitoring as necessary to assure compliance with standards for aquatic life and wildlife where known problems are occurring (1987 Plan, pages 73 and 190). Access to sites should be limited when State standards are exceeded and the public should be notified when water quality has not met State and Federal Standards at designated swimming sites (1987 Plan, page 190). Improving and protecting water quality is one of the main goals of Sedona/Oak Creek Ecosystem-wide and Flagstaff/Lake Mary Ecosystem management direction (1987 Plan, pages 206-10, 206-12, 206-22, 206-77, 78, 79).

Under the current plan, water quality in most streams within the forest is projected to remain static with some streams projected to move away from desired conditions. For example, since 1994, the water quality in Beaver Creek has varied or fluctuated from not-attaining to inconclusive and is projected to move away from desired conditions, mainly due to disturbances on private lands (Steinke 2016, USGS 2016).

Oak Creek water quality has had several exceedances of *E. coli* levels and has not improved or been removed from the not-attaining list during the life of the current plan. Water quality trends in Oak Creek are static to trending away from desired conditions, depending on the amount of recreation use. Impairments occur during high swimming and day use in the summer. A standard in alternative A mandates that water quality in Oak Creek must comply with Arizona water quality standards and the State Unique Water status of Oak Creek (1987 Plan, page 185) and there is a goal of reducing water quality impacts in Oak Creek by methods such as strategic placement of toilets, limiting equestrian use, targeted information on proper sanitation practices, and installing shower and hand-washing facilities and more gray-water disposal sites (1987 Plan, page 187-1).

Water quality in the five not-attaining reservoirs (Upper Lake Mary, Lower Lake Mary, Long Lake, Soldier, and Soldier Annex) and in Stoneman Lake is projected to remain static because there is no

direction in the current plan to implement recommendations in any TMDL. However, the forest is implementing portions of the TMDLs on an opportunity basis, therefore, although the trends for these waterbodies is currently static, the trends are expected to move toward desired conditions with implementation of the TMDLs. In addition, alternative A has standards and guidelines that would protect Stoneman Lake by prohibiting overnight camping in the basin, restricting dispersed recreation, and excluding livestock grazing below the rim of the basin (1987 Plan, pages 173 and 175).

Water Rights

Under alternative A, the forest would continue to maintain and procure water rights, including instream flow to provide water for domestic livestock and wildlife and to insure free-flowing conditions of perennial streams on NFS lands for aquatic wildlife habitat.

Other Effects

Wildfires Managed for Resource Objectives: Wildfires originating from natural ignitions (i.e., lightning) are being managed more frequently for multiple objectives under alternative A than in the past. These managed fires provide opportunities to return fire to fire-adapted ERUs in a manner consistent with historic fire regimes and behavior (i.e., low to moderate fire intensity and soil burn severity). Benefits include reduced density of young understory trees, release of nutrients stored in litter, improved nutrient cycling, increased vegetative ground cover and improved overall vegetative diversity and vigor, increased short term water yield and infiltration rates, all of which contribute to improved watershed condition**.**

Recommended Wilderness Areas: Alternative A does not recommend any new wilderness areas. Alternative A has restrictions and constraints that make it impractical to implement wildfire treatment in designated wilderness areas.

Research Natural Areas and Botanical and Geological Areas: Under alternative A, there are no suitability determinations on recreation within botanical and geological areas. However, there is language in the 1987 plan for botanical and geological areas that prohibits off-road driving, timber harvest, and fuelwood cutting, and does not allow rehabilitation of natural events (1987 Plan, pages 194 and 195). In addition, botanical areas are managed to protect and maintain their uniqueness and ecological condition; Allotment Management Plans would protect the uniqueness and ecological condition of these special areas; roads adjacent to these areas would be managed to prevent vehicular intrusions; and fire suppression tactics would minimize damage to the character of these special areas (1987 Plan, page 196). Although plan language in alternative A differs from the other alternatives, the consequences to water resources in botanical and geological areas are similar and minor in extent. This difference between alternatives would be minor in extent because there are few acres of riparian areas present and these special areas are small relative to the size and contributory effects on 6th code watersheds.

Old Growth: Under alternative A, old growth language for Pinyon Juniper with Grass, Pinyon Juniper Evergreen Shrub, Ponderosa Pine, Mixed Conifer with Frequent Fire, Mixed Conifer with Infrequent Fire, and Spruce-Fir ERUs is expected to result in higher basal area and more dense canopies and larger areas of canopy closure than other alternatives. This means there would be greater potential for uncharacteristic fire behavior that could result in high soil burn severity, accelerated erosion, sediment delivery to streamcourses, downstream flooding, and degraded water quality. There would be no appreciable effect on level terrain because accelerated erosion would be minimal and sediment is far less likely to be delivered to connected streamcourses. However, on steep slopes (greater than 15 percent), sediment delivery to streamcourses is far more likely to contribute to increased sediment in perennial streams. Due to the small overall acreage associated

with old growth, the amount of sediment delivery would be localized and not likely to affect overall water quality impairment at the watershed scale.

Alternative B (modified)

In addition to other plan direction that would indirectly benefit water resources (such as vegetation desired conditions), alternative B (modified) would provide the following plan direction directly related to water resources:

Watershed Condition

Watershed condition is expected to improve and trend would be toward desired conditions in contrast to a static trend under alternative A. Alternative B (modified) includes many plan components that support improvement in watershed condition. There are desired conditions for watersheds that exhibit high geomorphic, hydrologic, and biotic integrity within their inherent capability (FW-Water-DC-2). These desired conditions would provide more focused plan implementation with respect to 6th code watersheds, while alternative A does not. Therefore, overall watershed improvement at the 6th code watershed level would be expected under alternative B (modified), but not under alternative A. The guideline (FW-Water-G-2) directing watershed improvement on priority 6th code watersheds would result in trending toward proper functioning condition (Class 1).

In alternative B (modified), a management approach in Watersheds and Water recommends domestic supply watershed treatments be given priority and accelerated to help reduce the threat of crown fires, post-fire flooding, sedimentation impacts, and risk of wildfires that result in high soil burn severity. Where treatments occur in domestic water supply watersheds, watershed function, long-term soil productivity and water quality would be protected and restored at a faster rate than alternative A.

Groundwater

Alternative B (modified) has express guidance (FW-Water-DC-3, 5, 7 and FW-Water-G-3) protecting groundwater through beneficial soil and vegetation functions, maintenance of base flows, protection of water quality, and procurement of instream flows. Implementing this guidance would improve the ability of the soil to resist erosion, infiltrate water, and recycle nutrients. Riparian vegetation would improve along stream banks, wetlands, and springs, aiding in the ability to filter sediments; capture bedload; aid floodplain development; and improve flood-water retention, groundwater recharge, and intermittent and perennial streamflow, thereby reducing erosion, improving water quality and protecting against water quality degradation. Riparian area function would improve, as would floodwater retention, streamflow, and groundwater recharge. Consequently, maintenance of groundwater and water quantity including streamflow should be better protected and move toward desired conditions implementing alternative B (modified) more than alternative A. Lands of other ownership have seen substantial groundwater drawdown due to excessive well pumping, but are outside the control and authority of the forest. Consequently, the trend is away on non-forest administered lands and likely toward for alternative B (modified).

Water Quantity and Quality

Water yield was evaluated by looking at the distribution of open states in the Ponderosa Pine, Pinyon Juniper with Grass, and Mixed Conifer with Frequent Fire ERUs (representing improved water yield and characteristic fire). Evapotranspiration rates are increased by overly dense forests drawing more water, resulting in reduced water yield and stream flow to downstream riparian forests that depend on that water. The consequences of the prescribed cutting plan objectives in the Ponderosa Pine and Pinyon Juniper with Grass ERUs in alternative B (modified) (FW-TerrERU-PP-O-1, FW-TerrERU-PJ-O-1) on water yield is the same as in alternative A.

The consequences on water yield related to implementing the low range of the plan objective for prescribed cutting in the Mixed Conifer with Frequent Fire ERU under alternative B (modified) (FW-TerrERU-MC-MCFF-O-1) is also similar to alternative A for year 15 and year 50. In contrast, the high end of the plan objective under alternative B (modified) (FW-TerrERU-MC-MCFF-O-1) shows a positive trend toward desired conditions. In year 15, there would be about a 23 percent improvement in open states compared to existing. In year 50, there would be about a 26 percent improvement in open states compared to existing. Consequently, water yield would be expected to increase and the threat of uncharacteristic fire would be expected to decrease compared to the existing condition, and compared to alternative A.

Alternative B (modified) also includes other plan components that explicitly support open conditions that would result in higher levels of water yield than alternative A (FW-TerrERU-PJ-DC-1, FW-TerrERU-PP-DC-4, 8; FW-TerrERU-MC-MCFF-DC-1, 6; FW-WUI-DC-7). In addition, alternative B (modified) includes plan components that support base flow, water yield, and water infiltration within natural capability (FW-Water-DC-3, 5, 6; FW-Water-G-4, 6; FW-Rip-Spr-O-1; FW-Rip-Spr-G-1). This plan language is more explicit than alternative A and would result in stream base flow levels, water infiltration and water yield managed nearer to their natural capability than guidance under alternative A.

Overall, the forestwide trend for water quality under alternative B (modified) would be trending toward desired conditions, compared to a static trend in alternative A.

Alternative B (modified) includes guidelines that focus on improvement in priority 6th code watersheds and require implementation of approved TMDL recommendations (FW-Water-G-2, 5).

Alternative B (modified) focuses on promoting natural disturbances and reducing threats of uncharacteristic disturbances through several plan components (FW-Terr-ERU-All – G-4, FW-TerrERU-DC-DC-2,3, FW-TerrERU-Grass-DC-2, FW-TerrERU-IC-DC-3, FW-TerrERU-PJ-DC-3, 8, FW-Terr-ERU-PP-DC-2, 3; FW-TerrERU-PP-G-1; FW-WUI-DC-2, 3, 5, 7, 8, FW-Fire-DC-2, 3; FW-Eco-DC-1, 2, 3; FW-Rip-Strm-DC-4). Reducing threats of uncharacteristic fires would reduce the risk of high soil burn severity that could otherwise result in accelerated soil erosion, loss of protective vegetative ground cover and loss of tree and herbaceous species and riparian areas. In addition, in both current and recommended wilderness areas, the use of the wildfires managed for resource objectives would be more easily implemented (FW-Fire-DC-2, 3 and FW-Eco-DC-1) and is expected to protect long-term soil productivity, watershed function, water quality, and riparian function better than alternative A.

A Roads and Facilities guideline would protect water quality by promoting the use of temporary roads to reduce sedimentation into connected waters (FW-RdFac-G-8).

Forestwide plan components in alternative B (modified) explicitly support functional riparian areas and herbaceous vegetation. Functional riparian areas would reduce the risk of uncharacteristic fire, enhance flooding disturbance resiliency, and would filter sediment and protect water quality (FW-RiP-RipType-DC-1, 2, 3, 4; FW-Rip-All DC-1, 5, 6; FW-Rip-Strm-DC-1, 3).

Like alternative A, alternative B (modified) includes direction for the Inner Basin Management Area which provides water for the City of Flagstaff. In contrast to alternative A, alternative B (modified) includes two new management areas (C.C. Cragin Watersheds and the Lake Mary Watersheds MAs) that emphasize surface water sources for the Town of Payson and City of Flagstaff and serve public water systems. While alternative A has vague direction (1987 Plan, page 191) emphasizing protection of watershed condition on Upper and Lower Lake Mary and the Inner Basin, alternative B (modified) provides more specific guidance that could better protect water quality in all three of

these management areas (MA-InBsn-DC-4, MA-InBsn-G-4, MA-LkMry-DC-1, MA-LkMary-G-1, 2, MA-CCCrg-DC-1, MA-CCCrg-G-1, 2).

Forestwide plan language would also reduce the risk of uncharacteristic wildfire in public water supply watersheds, considered a part of the wildland-urban interface (FW-WUI-DC-2). Long-term soil productivity and water quality would therefore be better protected than under alternative A.

Water Rights

Under alternative B (modified), new and existing instream flow water rights are maintained or procured (FW-Water-G-3, FW-Water-MgtApp). Instream flow water rights would be maintained and procured at levels similar to alternative A and provide some level of protection of onsite streamflow.

However, streamflow is not a function of instream water rights only. With respect to streamflow, the plan language under alternative B (modified) is improved and more focused on riparian ecological function relative to alternative A and would support improving ecological function as they relate to water quantity and watershed function (FW-Rip-Strm-DC-3, 4 and FW-Rip-Stm-G-1). Consequently, instream flows would be less at risk with the implementation of alternative B (modified).

Other Effects

Wildfires Managed for Resource Objectives: Use of wildfires managed for resource objectives in recommended wilderness areas could better protect watershed function and water quality than alternative A. Wildfires managed for resource objectives in fire-adapted ERUs would reduce ERU departure, lower the risk of uncharacteristic fire, and help restore the natural fire vegetation class and fire return interval. Short-term exceedances of water quality would be expected; however, the risk and magnitude of this effect would be less than what could result from uncharacteristic fire and fuel loads from vegetation continued to increase.

Recommended Wilderness Areas: The inclusion of the Abineau, Davey's and Strawberry Crater Recommended Wilderness Areas would not impact (improve or degrade) water quality, water yield, groundwater, and watershed condition because these areas are remote and currently have few human disturbances. In addition, livestock grazing impacts would continue (where authorized) and there are limited perennial waters (very small extent of Fossil Creek in Davey's) and riparian areas present to be impacted.

Use of wildfires managed for resource objectives in recommended wilderness areas could better protect watershed function and water quality than alternative A. Wildfires managed for resource objectives in fire-adapted ERUs would reduce ERU departure, lower the risk of uncharacteristic fire, and help restore the natural fire return interval. Short-term exceedances of water quality would be expected; however, the risk and magnitude of this effect would be less than what could result from uncharacteristic fire and fuel loads from vegetation continued to increase.

In many wildfires, the use of mechanized or motorized equipment and associated tools is required for wildfire control, but would be restricted in wilderness areas (except when a Minimum Requirements Decision Guide analysis is approved), which would allow for minimal use of such tools to preserve wilderness character or comply with other Federal laws. Plan language for recommended wilderness could constrain the use of mechanized equipment (SA-RWild-DC-1, 2) which in some areas would be important for pre-treatment to reduce the negative effects of fire. This could result in fewer opportunities in the ability to control wildfires when needed. Consequently, designation of recommended wilderness areas could put the soil and watershed at higher risk of uncharacteristic wildfire that could result in areas of high burn severity, which can accelerate soil loss and delivery

sediment to connected streams impairing water quality. However, the overall affected area is limited and represents a small fraction of each ERU.

The recommendation of wilderness areas in alternative B (modified) is not expected to better protect water and riparian resources from human disturbances than alternative A because Abineau and Strawberry recommended wildernesses have no water or riparian vegetation and Davey's recommended wilderness has a low amount of perennial water and only 21 acres of Mixed Broadleaf Deciduous Riparian Forest. There are few current impacts to water and riparian resources in Davey's. Riparian forest types and water quality are not expected to be better protected within recommended wilderness than without the recommendation primarily because of the small amount of water and riparian vegetation. Therefore, water quality, watershed function and long-term soil productivity would not differ from alternative A.

Research Natural Areas and Botanical and Geological Areas: Alternative B (modified) proposes West Clear Creek RNA in a new location, Rocky Gulch RNA, and the eastern expansion of the San Francisco Peaks RNA. This alternative would also designate a new special area, the Cottonwood Basin Botanical and Geological Area.

Plan language associated with established and proposed research natural areas is expected to positively impact water quality, water yield, groundwater (springs), or watershed condition in these localized areas because desired conditions promote little evidence of human activity or disturbance and promote the maintenance of natural conditions and processes (SA-RNABotGeo-DC-1, 2). Likewise, desired conditions promote the maintenance of the inherent physical and biological properties of botanical areas and geological areas, support no negative impacts by human activities or permitted uses, and encourage the continuation of natural processes (SA-RNABotGeo-DC-5). In addition, plan guidelines would protect the ecological condition and uniqueness of proposed and designated RNAs and designated geological and botanical areas in regard to human activities, permitted uses, and types and levels of access including allotment management plans and fire management (SA-RNABotGeo-G-1, 2, 3, 4, 5, 6, 7, 9).

Under alternative B (modified), mechanized travel in proposed and designated research natural areas is not suitable. Likewise, mechanized travel in designated botanical areas and geological areas is not suitable, except on designated trails (Chapter 4, Suitable Uses). This would not impact water quality, watershed function, water yield, groundwater because of the small area affected.

Old Growth: Unlike alternative A, implementation of all action alternatives would guide old growth toward smaller and fewer patches having continuous canopy closure, resulting in less risk of localized uncharacteristic fire behavior, fewer acres of high soil burn severity and less sediment delivery into connected streamcourses. Alternative B (modified) has updated language related to old growth that reflects current science and emphasizes natural disturbance regimes. This alternative also differs from alternative A in the spatial arrangement of old growth. In ERUs that experience more frequent fire disturbances, old-growth components are expected to be present throughout the landscape as individuals, as part of small multi-aged groups and occasionally in small even-aged groups. This structure and distribution is not only supported by the best available science, but also provides greater protection from losses due to disturbances (like insect, disease and uncharacteristic wildfire) than would be provided under alternative A.

In ERUs that experience less frequent fire disturbances, there is less of a difference in the effects between alternative A and alternative B (modified). Both alternatives recognize that the old growth component aggregations are typically larger than in frequent fire ERUs, but the desired conditions

under alternative B (modified) explicitly describe how these aggregations vary in space and time (FW-TerrERU-SF-DC-2 and FW-TerrERU-MC-MCIF-DC-2).

Updates to old growth language should promote characteristic disturbances and reduce the threat of undesirable fire effects, (e.g., areas of high soil burn severity, accelerated soil erosion, and sediment delivery to streamcourses) that could otherwise reduce water quality especially on steep slopes with high soil erosion hazard. However, the reduced threats would be minor in extent and magnitude since affected areas are small and non-contiguous. Benefits to water quality are not expected to be measurable at the stream level and watershed function would not be affected at the watershed level.

Alternative C

Overall, implementing plan language in alternative C would have similar effects to groundwater, water quality, and water rights as those described in alternative B (modified).

Watershed Condition

Alternative C would provide additional and more specific guidance for soil and riparian function, watershed condition and function in the eight management areas that emphasize reduced human-related disturbance. Alternative C includes desired conditions that explicitly focus on protection or improvement of riparian habitat, springs, wetlands, watersheds, soils, water resources, fire regimes, and recreation for these management areas (Appendix F, MA-AMesa-DC-1, 2, 3, 6, 9, and 10; MA-PGrove-DC-1, 2, 3, 6, 9, and 10; MA-Jack-DC-1, 2, 3, 6, 9, and 10; MA-ScndChnc-DC-1, 2, 3, 6, 9, and 10; MA-BlueRidge-DC-1, 2, 3, 6, 9, 10, and 11; MA-Limestone-DC-1, 2, 3, 6, 9, 10, and 12; MA-HospRdg-DC-1, 2, 3, 6, 9, 10, 11, and 12; MA-KnollLake-DC-1, 2, 3, 6, 9, 10, and 12). There would be limitations on public road density, motorized travel and large group recreation events in these MAs (Appendix F, MA-AMesa-G-1, 2, 3, and 4; MA-PGrove-S-1; MA-PGrove-G-1, 2, and 3; MA-Jack-G-1, 2, and 3; MA-ScndChnc-G-1, 2, and 3; MA-BlueRidge-G-1, 2, and 3; MA-Limestone-G-1, 2, and 3, 6; MA-HospRdg-G-1, 2, and 3; MA-KnollLake-G-1, 2, and 3).

Alternative C has the potential to close up to 71.8 miles of road to public use in seven of the management areas that emphasize reduced human-related disturbance. The miles open of road open to public use would not change in the Second Chance MA. The actual miles closed to the public would be determined by subsequent decisions after consideration of project-level analysis and public comment. The limited nature of these potential road closures is not expected to result in a measurable water quality differences. The Upper Clear Creek 5th HUC watershed contains the most number of perennial streams on the forest. This HUC is partially located within the Blue Ridge MA, which has 39.6 miles of road that has the potential to be closed to the public over time. There is very little roads connectivity or road density to stream courses on open road systems in this management area. GIS analysis shows only about 0.3 mile is connected to streamcourses and within 120 feet of any stream course. Roads farther than 120 feet were assumed to have adequate vegetation to trap and buffer sediment, so sediment would not be delivered to connected streams and degrade water quality. It is highly unlikely that limiting motorized traffic on these roads would result in a measurable reduction of sediment delivery or water quality improvement in any perennial waters within this watershed due to the low extent and magnitude of road closures that connect to perennial waters. Therefore, existing road density and road closures are not expected to protect or improve water quality any better than all other alternatives.

The consequences of forestwide language on watershed condition would be the same as in alternative B (modified). Although management direction explicitly focuses on protection or improvement of riparian habitat, springs, wetlands, watersheds, soils, and water resources in the eight MAs that emphasize reduced human-related disturbance, there are already forestwide and ERU-specific plan components that guide management similarly. The direction in the MAs may

focus more attention on the importance of protecting or restoring watersheds contained in them, but similar direction already exists and should be sufficient to guide management toward protection and improvement of these resources. Therefore, there is no clear advantage of creating the new management areas that emphasize reduced human-related disturbance compared to the language contained in alternative B (modified) for protection and restoration of watershed function and the water, riparian, and soil resources that contribute to watershed function.

Water Quality

Water quality in some of the MAs that emphasize reduced human-related disturbance (Blue Ridge, Hospital Ridge, Jacks Canyon, Knoll Lake, Limestone Pasture, Pine Grove, and Second Chance) would be protected similar to alternative B (modified) because plan language in these MAs would support the protection and restoration of streams, springs, and wetlands, and plan language would promote identified designated beneficial uses in streams and perennial waters. Forestwide language regarding water quality would be the same as in alternative B (modified).

Other Effects

Wildfires Managed for Resource Objectives: Wildfires managed for resource objectives in fire-adapted ERUs would reduce ERU departure, lower the risk of undesirable fire effects and help restore the natural fire vegetation class and fire return interval. Short-term adverse effects to water quality would be expected; however, the risk and magnitude of these effects would be less than what could result from uncharacteristic fire and fuel loads from vegetation continued to increase.

Alternative C would not include plan language that makes it impractical to use wildfire managed for resource objectives in wilderness areas to achieve desired conditions for fire-adapted ERUs. As a result, under this alternative there would be more opportunities to manage wildfires to achieve resource objectives than under alternative A because of the updated plan language. Therefore, implementation of plan language under alternative C would protect soil and water resources and watershed function a little better than alternative A and about the same as alternative B (modified) in wilderness areas.

In many wildfires, the use of mechanized or motorized equipment and associated tools is required for wildfire control, but this would be restricted in wilderness areas (except when a Minimum Requirements Decision Guide analysis is approved), which would allow for minimal use of such tools to preserve wilderness character or comply with other Federal laws. Plan language for recommended wilderness could constrain the use of mechanized equipment (SA-RWild-DC-1, 2) which in some areas would be important for pre-treatment to reduce the risk of undesirable fire effects. This could result in reduced ability to control wildfires when needed. Consequently, designation of recommended wilderness areas could put soil and watershed resources at higher risk of undesirable wildfire effects that could result in areas of high soil burn severity, which can cause accelerated soil erosion and sediment delivery to streamcourses resulting in water quality impairment. Alternative C contains the most acres of recommended wilderness (91,757 acres), compared to alternative B (modified) (8,733 acres) and alternative A (0 acres). Accordingly, alternative C has the potential for these undesirable fire effects to occur on more acres than those alternatives. However, like alternative B (modified), the overall affected area is limited and represents a small fraction of each ERU.

Recommended Wilderness Areas: Recommendation of new wilderness areas in alternative C could indirectly protect water quality in perennial streams of seven recommended wilderness areas within portions of Barbershop, Black Mountain, Cedar Bench, East Clear Creek, Davey's, Walker Creek, and Hackberry better than alternative A. Like alternative B (modified), but unlike alternative A, alternative C facilitates the use of wildfires managed for resource objectives (FW-TerrERU-PP-G-1,

SA-Wild-DC-4) in both recommended and designated wilderness. The recommended wilderness areas in alternative C would include about 1,300 acres of riparian forest, which is about 12 percent of the total riparian forest acreage on the Coconino NF. Some riparian forest acreage is hard to access and has little human disturbance while other areas are more accessible to recreation.. In areas of limited access, water quality is not expected to be better protected under wilderness recommendation, but in accessible areas, water quality could be better protected in a recommended wilderness because plan direction would promote activities and structures to be consistent with wilderness character (e.g., structures, new trails, etc.) (SA-RWild-DC-1, 2, 5, 6, and G-1, 2, 3, 4, and 5). The recommendation of new wilderness areas in alternative C is not expected to offer additional protection or reduced human disturbance of soils, water quality, or watershed function at the landscape level but would improve protection in localized areas.

Research Natural Areas and Botanical and Geological Areas: Alternative C includes a guideline that states that livestock grazing should be excluded from research natural areas unless the grazing supports or would not affect the area's research purpose (Appendix F, SA-RNABotGeo-G-4). Compared to alternative B (modified), this guideline is not expected to provide better protection or improvement of water quality in perennial waters because very little perennial water is connected to the limited grazing that occurs in these areas.

Old Growth: Alternative C would have similar effects as alternative A in the areas where at least 20 percent of each forest or woodland ERU was allocated to old growth in 100- to 300-acre stand sizes. This pattern and structure would result in higher basal area and more dense canopies and larger areas of canopy closure in these areas. These blocks would be at a greater risk of loss to disease and uncharacteristic wildfire because they would generally be composed of similar sized trees and would have more closed and continuous canopies. In these areas, understory vegetation and shade intolerant species such as Gambel oak and aspen would also be suppressed due to limited sunlight. Old growth would be allocated by 6th code watershed rather than 10,000-acre blocks. Alternative C would have similar effects as alternative B (modified) in the areas outside of allocated old growth.

Alternative D

Overall, implementing plan language in alternative D would about have about the same effects to watershed condition, groundwater, streams, water quality, and water rights as those described in alternative B (modified).

Alternative D recommends no wilderness, so the consequences are similar to alternative A. Managing wildfires for resource objectives could be slightly more effective because no new wilderness areas are proposed and wilderness restrictions on the use of mechanized equipment in those areas are not at issue. However, the overall reduced restrictions are not expected to appreciably improve the use of wildfires with resource objectives at the watershed level and would only improve a fraction of the area (Vegetation and Fire specialist report, USDA Forest Service 2016c).

Cumulative Effects for Watersheds and Water, Riparian Areas, and Soil

The cumulative effects are being assessed at the 4th code watershed or subbasin scale (table 5) forestwide across ERUs and are temporally bounded by the next 10 to 15 years. Activities are considered that result in disturbances to vegetation, compact or detach soil and, therefore, reduce soil condition, function, and productivity.

Because it is impractical to complete a quantitative cumulative watershed effects analysis at this scale of strategic planning, effects are evaluated qualitatively. Detailed quantitative cumulative watershed effects analyses are be analyzed at the project level. Nearly all of the management

activities conducted by the forest have the potential to affect watershed condition, water, riparian areas, soil function, condition, and productivity. Their cumulative impact to a watershed depends upon the actions and the watershed's sensitivity to disturbance.

Table 5 displays the 4th code HUC watersheds intersecting the forest. Influences come from within and outside of the forest boundary and cumulatively impact soil and water resources. Percentages of each 4th code watershed administered by the forest are displayed and are relevant to the potential cumulative effects Coconino NF activities may contribute to the subbasins. The percentage of lands managed within the subbasins by the forest ranges from less than 1 percent to 57 percent.

Table 5. 4th code watersheds and percent ownership

4th Code Watershed	Percent Watershed on the Forest	Percent Watershed Off Forest
Havasu Creek – 2,933 square miles	0.2%	99.8%
Middle Little Colorado River – 2,522 square miles	15%	85%
Canyon Diablo – 1,199 square miles	57%	43%
Lower Little Colorado River – 2,393 square miles	15%	85%
Tonto Creek – 1,048 square miles	0.2%	99.8%
Upper Verde River – 2,507 square miles	40%	60%
Lower Verde River – 1,965 square miles	24%	76%
Forest Totals at 4th code Scale	**19.7%**	**80.3%**

All of the watersheds associated with the forests have private inholdings and appreciable areas outside of the forest boundary (ranges from 43 to 99 percent). Many of the impacts occur on lands of other ownership, such as unpaved roads, grazing, recreation that may result in reduced watershed condition, water quality, riparian condition, soil function, soil condition, and productivity. Activities on state and private land are not in the control of the forest. These activities could cumulatively affect and are probably at greater risk of watershed, riparian area, and soil degradation than on NFS lands. This would occur in private, tribal, or city owned lands where land development and greater ground disturbance generally occurs compared to NFS lands. The activities described below could cumulatively affect watershed, riparian area, and soil condition on the Coconino NF.

Urbanization near and adjacent to the forest can contribute substantially to cumulative watershed effects. Development has the potential to affect watershed condition, riparian areas, and soil resources through accelerated erosion and loss of soil productivity. As private properties, especially inholdings, change from ranch or undeveloped land to subdivisions or higher density uses, encroachment into national forest becomes more frequent resulting in resource impacts and decline in watershed and riparian area condition, as well as soil function and condition. All of these activities tend to increase the level and area of disturbance, reduce watershed, riparian, and soil condition and long-term soil productivity within the administrative boundary of the forest to a degree that may be greater than forest management activities under all alternatives in those affected areas.

In addition to the above potential impacts, activities on lands of other ownership that have a high risk of adverse impacts to watershed, riparian areas, and soil, include mining, increased trail density and use, and trampling of riparian areas.

Entities like The Nature Conservancy and Verde Valley Land Preservation Institute can assist in acquiring key parcels, particularly related to riparian and the Verde River that would help maintain or

improve watershed, riparian, and soil conditions. The Nature Conservancy's interest in acquiring Verde River properties and water rights may result in continued land acquisition cases depending on available funding. The interest in protecting the Verde River may become higher as Northern Arizona University works on their Verde Valley Initiatives. Support for land acquisition or other forms of protection of the Verde River and its tributaries may result in protection of watershed and water resources, riparian areas, and overall soil function, condition, and productivity both outside and within forest boundaries in the Middle and Lower Verde 4th code watersheds.

Implementation of Travel Management Rule decisions across the Coconino NF and adjacent national forests would appreciably improve watershed, riparian, and soil conditions with the closure of many roads and dispersed campsites outside riparian areas and springs. The Prescott and Kaibab have completed similar travel management decisions, and the analysis for the Apache-Sitgreaves National Forests is in progress. These decisions would restrict motorized cross-country travel and limit and close many high-risk roads that may pose a risk to water, riparian area, and soil quality. These actions should cumulatively reduce onsite erosion and, overall, maintain or improve watershed condition, riparian areas, and soil productivity. Once a decision is made on the Apache-Sitgreaves National Forests, similar effects are expected.

Neighboring forests with similar forest plan revisions include the Prescott, Kaibab, and Apache-Sitgreaves National Forests. The Coconino NF shares portions of 4th HUC watersheds and, therefore, planning efforts directing watershed, riparian area, and soil resource management would indirectly impact all forests. The aforementioned forests have developed plan guidance and desired conditions similar to the Coconino NF, and are expected to move these resources toward identified desired conditions, resulting in maintenance or improvement of watershed, riparian area, and soil condition and productivity.

Other projects or planning efforts that would generally result in management direction that would improve soil condition and productivity, as well as associated water quality and riparian and watershed function, and would not contribute to negative cumulative effects to watershed, riparian area, and soil condition include Flagstaff Regional Plan, Verde Valley Regional Plan, Sedona community plan, national monuments' management plans, Sedona and Flagstaff community fire plans, State Lands Department plans, Rogers Lake, and Coconino County Open Space Plan.

Riparian Areas

Riparian areas on the Coconino NF include perennial and intermittent streams, lakes, wetlands, springs, and their associated riparian zone.. Riparian vegetation is an interface between terrestrial uplands and water, is characterized by vegetation that is adapted to flooding as a natural disturbance, and is highly associated with water. Water-dependent plants near the water often transition to a combination of upland and riparian species as distance from water increases.

Riparian function was evaluated from onsite assessments and, at a finer scale than midscale vegetation analysis used for terrestrial ERUs, integrates the contributions to ecosystem resiliency and threats for soil, water, and vegetation interactions. This section describes the departure and trend of each of the riparian areas, in terms of their riparian function, which is tied to proper functioning condition (PFC).

PFC was evaluated using the Riparian Area Survey and Evaluation System or RASES (USDA Forest Service 1989), which is a site-specific riparian survey method. RASES is used to map and evaluate riparian reaches, including the type and location of stream riparian areas; in this case, riparian forest types. It measures vegetation, soil, stream channel, and water characteristics and delineates riparian

type. Another consideration in assigning PFC classes to riparian reaches was the data collected on-site. The Coconino NF riparian GIS layer has been updated using RASES data and more recent Regional Riparian Mapping Project (RMAP) mapping (Triepke and others 2013). This resulted in more accurate mapping and the consequent identification of additional cienegas in the Wetland spatial layer and additional acres of Montane Willow Riparian Forest. RASES uses a narrower geographical extent than RMAP and, therefore, interpolating these two data sources requires the assumption that the larger, regionally mapped area is proportionally in the same condition as the RASES onsite evaluation. RMAP classified riparian vegetation into riparian ERUs. Plan language in the revised forest plan divides riparian forests into three broad riparian forest type categories. A crosswalk between riparian ERUs and riparian forest types is located in Appendix E of the forest plan.

Affected Environment

Streams and Riparian Forest Types

Forest RASES inventory shows there are about 778 miles of stream system riparian areas on the forest including those miles located on private lands. There are approximately 677 miles of riparian areas on forest-administered lands. About 62 percent of these areas are in proper functioning condition which means that adequate vegetation, landforms, or large woody debris is present to dissipate stream energy associated with high flows; filter sediment, capture bedload, and aid in floodplain development; improve floodwater retention and groundwater recharge; develop root masses that stabilize streambanks; develop diverse ponding and channel characteristics to provide habitat for fish, waterfowl and other uses, and support greater biodiversity. When riparian forests are properly functioning, vegetation composition, structure and function is diverse, productive, and provides habitat for those species that rely on them for their survival.

About 28 percent are in functional-at-risk condition which means that they are in functional condition, but they have an existing soil, water, or vegetation attribute to make them susceptible to degradation. Areas that are functional-at-risk are less resilient to threats to their vegetation types. However, riparian areas in functional-at-risk condition still provide enough diverse ecological conditions (including plants) to support wildlife, fish, and rare plants, and have the capability to improve plant and soil composition, structure, and function.

About 5 percent are in nonfunctional condition. This means they lack adequate vegetation, landform, or large woody debris to dissipate stream energy associated with high flows and, thus, are not reducing erosion or improving water quality. Riparian areas that are nonfunctional have the lowest level of plant diversity, are most vulnerable to threats, and comparatively, contribute the least toward ecological sustainability compared to PFC and functional-at-risk classes. Functional-at-risk and non-functional riparian conditions represent departures from reference conditions.

Most of the remaining lack condition information because they were too remote to provide onsite evaluation or are non-riparian. Inaccessibility means there is probably low impact from human disturbances and threats.

Table 6 displays the miles of stream by riparian functional condition and by 5th and 4th HUC. The main perennial streams within the 5th code HUCs are also displayed. All 5th code HUCs have some stream miles classified as functional at-risk except Lower Clear Creek. The following 5th code HUCs have some stream miles classified as non-functional: Walnut Creek, West Clear Creek, Upper Clear Creek, and Beaver Creek.

The perennial streams of most concern are portions of East Clear Creek and its tributaries, Beaver Creek, Oak Creek, Fossil Creek, Dry Beaver Creek, Red Tank Draw, Walker Creek, and the Verde River.

Threats common to streams and riparian forest types include uncharacteristic fire, dense upland forest conditions, dispersed recreation, roads and trails that occur in riparian areas or are hydrologically connected to them, upland grazing management practices, water diversion and use, and herbivory in riparian areas by domestic livestock and wildlife ungulates:

Uncharacteristic fire in fire-adapted ERUs. The increased risk of uncharacteristic fire results from past fire exclusion, which allowed forest conditions to become denser and more prone to fires that burn into the tree canopy, rather than predominantly in the understory. Uncharacteristic fires can result in high soil burn severity, accelerated erosion and excessive sedimentation to streamcourses, excessive or increased water flow, and uncharacteristic flooding, which can result in stream channel scour, incision, and degradation and removal of vegetation and coarse woody debris in the riparian forest types. Uncharacteristic fire can also spread from adjacent fire-adapted ERUs into riparian forest types, especially during drought. These conditions result in loss of vegetation and drying of the riparian area, which can facilitate establishment or spread of invasive non-native vegetation.

Dense forest conditions: Past fire exclusion has resulted in increased stand densities in upland areas topographically above or adjacent to riparian forest types. The increased tree density has resulted in increased evapotranspiration by trees in these upland areas, reducing the amount of water in the soil unsaturated zone, or vadose zone (i.e., water in soil above the permanent groundwater surface). These conditions have adversely affected aquifer recharge and groundwater discharge to surface waters, including springs and stream channels. Forest thinning in upland areas followed by reintroduction of fire to fire-adapted ERUs is expected to increase short-term vadose water. Springer et al. (2006) determined that a frequent reintroduction of fire following forest thinning and initial prescribed fire could maintain soil water levels sufficient for maintenance of conditions conducive to healthy riparian ecosystems.

Table 6. PFC Classes (miles and percent) by stream riparian length in 4th and 5th HUC watersheds on forest-administered lands

HUC 4 name	HUC 5 name (and Main Perennial Streams)	Functional class	Miles	% of HUC5	% of HUC4
Canyon Diablo	**Canyon Diablo**	AT RISK	1.9	100%	6%
	Canyon Diablo Total		**1.9**		
	Rio de Flag	AT RISK	2.1	54%	6%
	(Rio de Flag)	PFC	1.8	46%	5%
	Rio de Flag Total		**3.9**		
	Walnut Creek	AT RISK	20.1	74%	61%
	(None)	NON-FUNCTIONAL	1.5	5%	4%
		NON-RIPARIAN	1.5	6%	5%
		PFC	4.2	15%	13%
	Walnut Creek Total		**27.3**		
Canyon Diablo Total			**33.1**		
Lower Verde River	**Fossil Creek-Verde River**	AT RISK	19.7	24%	14%
	(Fossil Creek, Verde River)	NON-RIPARIAN	3.0	4%	2%
		PFC	52.4	65%	37%
		UNK*	5.7	7%	4%
	Fossil Creek-VR Total		**80.8**		
	West Clear Creek	AT RISK	7.4	12%	5%
	(West Clear Creek, Clover Creek)	NON-FUNCTIONAL	1.9	3%	1%
		NON-RIPARIAN	4.5	7%	3%
		PFC	47.2	77%	33%
	West Clear Creek Total		**61.0**		
Lower Verde River Total			**141.8**		
Middle Little Colorado River	**Lower Clear Creek (East Clear Creek)**	PFC	16.5	100%	8%
	Lower Clear Creek Total		**16.5**		
	Upper Clear Creek	AT RISK	49.4	25%	23%
	(Barbershop, Bear Canyon, Buck Springs, Dane, East Bear, East Clear Creek, Leonard Canyon, General Springs, Houston Draw, Leonard Canyon	NON-FUNCTIONAL	22.3	11%	10%
		NON-RIPARIAN	0.2	0%	0%
		PFC	126.2	64%	59%
	Upper Clear Creek Total		**198.1**		
Middle Little Colorado River Total			**214.6**		

HUC 4 name	HUC 5 name (and Main Perennial Streams)	Functional class	Miles	% of HUC5	% of HUC4
Upper Verde River	**Beaver Creek**	AT RISK	39.2	33%	14%
	(Dry Beaver Creek, Red Tank Draw, Walker Creek, Wet Beaver Creek)	NON-FUNCTIONAL	4.8	4%	2%
		PFC	75.5	63%	26%
	Beaver Creek Total		**119.5**		
	Cherry Creek-Verde River (Beaver Creek, Verde River)	AT RISK	5.1	100%	2%
	Cherry Creek-Verde River Total		**5.1**		
	Grindstone Wash-Verde River (Verde River)	AT RISK	6.3	100%	2%
	Grindstone Wash-Verde River Total		**6.3**		
	Oak Creek	AT RISK	27.5	25%	10%
	(Oak Creek, Sheepshead Canyon, Spring Creek, Munds Canyon)	PFC	57.2	51%	20%
		UNK	27.4	24%	10%
	Oak Creek Total		**112.0**		
	Sycamore Creek	AT RISK	7.7	17%	3%
	(Sycamore Creek)	PFC	36.8	83%	13%
	Sycamore Creek Total		**44.5**		
Upper Verde River Total			**287.4**		
Grand Total			**676.9**		

* Unknown areas were not inventoried for PFC because access is difficult. It is probable that many areas are PFC because access by people and livestock is limited and, therefore, riparian areas are not greatly disturbed. However, overall PFC departure for Fossil Creek-Lower Verde River is 35 percent (23.1 divided by 42.5 known condition miles)

Dispersed recreation has the potential to remove or damage riparian vegetation, compact soil, and destabilize stream banks when excessive. In doing so, it creates areas of bare soil that leads to erosion and sedimentation into streams and reduces riparian function and water quality. Bare soils can readily become sites where non-native and invasive plants become established, which can further alter riparian vegetation communities.

Roads and Trails in riparian forest types can redirect and concentrate surface water flows. This can result in decreased flows in some areas and excessive flows in others, altering water availability to riparian vegetation. The bare areas of roads and trails are prone to accelerated erosion and due to close proximity to stream channels have potential to deliver sediment directly to stream channels. They can also deliver sediment into adjacent riparian areas and bury riparian vegetation, including tree seedlings, reducing localized riparian forest regeneration potential.

Upland grazing management practices can result in areas of reduced vegetative cover and bare soils where livestock concentrate for long periods or where trampling and trailing occurs. The consequences can include reduced water infiltration from bare areas leading to increased surface

runoff and accelerated soil erosion, sediment delivery to riparian areas resulting in damage or loss of riparian vegetation, degradation of surface water quality, channel incision, headcutting, and gully formation.

Water Diversion and Use interrupts stream flow and prevents surface water from reaching riparian areas. Livestock tanks capture flow that could otherwise contribute to baseflow in riparian streamcourses. There are numerous springs on the Coconino NF that have been developed (flow captured and diverted to troughs and water tanks) to support domestic livestock water needs.

Herbivory by domestic livestock and wildlife ungulates poses a risk to riparian areas through livestock foraging in riparian areas, reducing the amount and areal extent of riparian vegetation. Wildlife ungulates (particularly elk) browse in riparian areas. Grazing and browsing has been shown to lower riparian vegetation densities, reduce riparian diversity, reduce ecosystem functions, and alter both terrestrial and aquatic habitats (Fleischner 1994). Currently, the forest does not permit livestock grazing along the Verde River. This restriction has resulted in improved riparian conditions along the river during the last 10 years. Many other allotments have also reduced occurrence of livestock grazing in perennial streams to hardened areas or to times when grazing pressure does not adversely affect riparian area condition.

The threats listed above are discussed under environmental consequences to the extent that the Forest Service can influence them.

Localized areas in the Upper Clear Creek 5th code HUC are at risk because of dispersed recreation and ungulate herbivory, which is under control of the Arizona Game and Fish Department. This HUC includes East Clear Creek, its tributaries and intermittent stream courses with riparian habitat. The areas of most concern are those that are accessible to human activities.

This HUC is also recovering from a legacy of improperly located and poorly maintained roads (especially user-created roads) and a legacy off-highway vehicle use.

Legacy issues refer to vegetation removal, soil compaction, soil loss, and erosion associated with historic grazing; with areas that were open to off-highway vehicles prior to implementation of the Travel Management Rule; and with improperly located roads or past road maintenance. Soil and vegetation conditions that are a consequence of these legacy issues are expected to improve over time as the affected areas heal.

The accessible areas of the Beaver Creek 5th code HUC are at risk because of dispersed recreation. This HUC is also recovering from a legacy off-highway vehicle use, a legacy of improperly located and poorly maintained roads (especially user-created roads), and legacy livestock grazing. This HUC includes Beaver Creek, Dry Beaver Creek, Red Tank Draw, Walker Creek, and some intermittent stream courses with riparian vegetation.

The accessible areas of the Oak Creek 5th code HUC are threatened by dispersed recreation and affected by a legacy of improperly located and poorly maintained roads (especially user-created roads and social trails). The lower portion of Oak Creek is affected by legacy grazing issues and legacy off-highway vehicle use. This HUC includes Oak Creek, Spring Creek, and intermittent stream courses with riparian vegetation. Legacy road, off-highway vehicle use, and grazing issues refer to vegetation removal, soil compaction, soil loss, and erosion associated with past grazing practices; with areas that were open to off-highway vehicles prior to implementation of the Travel Management Rule; and issues with past road maintenance. Although some of the causes of the departures have been addressed, particularly with implementation of the Travel Management Rule,

the sedimentation into connected watercourses, and the soil and vegetation issues should gradually decrease as the affected areas heal.

Portions of the Fossil-Lower Verde River 5th code HUC are at risk of high amounts of dispersed recreation. This HUC is recovering from legacy off-highway vehicle use and poorly located and maintained roads (especially user-created roads).

There are three riparian forest types on the Coconino NF: Cottonwood Willow, Mixed Broadleaf Deciduous, and Montane Willow.

Cottonwood Willow Riparian Forest type is patchily distributed along the lower-elevation and low-gradient reaches of perennial streams including the Verde River, Towel Creek, Lower Oak Creek, Lower West Clear Creek, and Dry Beaver Creek. Much of this riparian forest is along the Verde River, and lower Oak Creek, and is either privately owned or managed by Arizona State Parks. Flooding is the primary disturbance. The seasonality and the quantity of water in floods are key factors in the germination and establishment of riparian vegetation. Cottonwood Willow Riparian is impacted by excessive or poorly timed livestock grazing in localized areas, which can remove excessive amounts of vegetation, contribute to a loss of soil function, and alter vegetation structure and composition. Cottonwood Willow is impacted by some highly invasive weeds such as tamarisk, tree of Heaven, and giant reed. Riparian-dependent weeds are anticipated to cause a decline in quality of native species regeneration and cause a potential reduction in instream flows because they draw more water from the water table than native trees (USDA Forest Service 2009a). In addition, there have been significant increases in fire intensity and severity in Cottonwood Willow Riparian Forest in the Southwest due to invasive species, primarily tamarisk and Russian olive. Severe fires remove cottonwoods from burn areas and can convert these sites to a non-native species mix. This riparian forest type is moderately departed from reference condition and trending slowly toward desired conditions on the Verde River and Towel Creek. The trend is static on some portions of the Verde River, Dry Beaver Creek, and Lower Oak Creek where there is private land and high recreation use (table 7).

Mixed Broadleaf Deciduous Riparian Forest type is patchily distributed across the forest and includes Sycamore Canyon, West Clear Creek, Middle and Upper Oak Creek, Red Tank Draw, Wet Beaver Creek, Walker Creek, and Fossil Creek, and associated tributaries. It consists of a vegetation mix of riparian woodlands and shrublands with various dominant species, depending on site-specific characteristics. It often contains oaks and conifers, including Arizona cypress, from adjacent uplands. Flooding and drought are the primary disturbances.

Mixed Broadleaf Deciduous Riparian Forest type is also affected by invasive exotic species that rank high for invasiveness or are difficult to control such as diffuse knapweed, yellow starthistle, Himalayan blackberry, and Malta starthistle. Exotic annual grasses, such as red and ripgut brome, are widely dispersed at variable densities, can cause major changes in ecosystem integrity if not controlled, and could shorten the fire return interval. Plants of this ecosystem are not adapted to the frequency at which exotic annuals burn (USDA Forest Service 2009a). Mixed Broadleaf Deciduous Riparian Forest type is also potentially impacted by excessive or poorly timed livestock grazing, which can remove excessive amounts of vegetation, contribute to a loss of soil function, and alter vegetation structure and composition within the vegetation type.

Mixed Broadleaf Deciduous Riparian Forest type has a low departure relative to reference conditions and is trending slowly toward reference conditions except portions of Fossil Creek and Wet Beaver Creek are static or trending away from reference conditions where recreation impacts occur (table 7).

Montane Willow Riparian Forest type is scattered along perennial streams such as East Clear Creek and its tributaries, seasonally intermittent streams such as in the Fern Mountain Botanical Area, wet meadows, and isolated springs at higher elevations. Trees include Bebb's willow, narrowleaf cottonwood, velvet ash, cherry, box elder, Arizona walnut, and Arizona alder. Dominant shrubs include red osier dogwood, willows, and woods rose. The understory consists of a variety of grass and grasslike species, including sedge, spikerush, and deergrass. Outlying populations of this vegetation type may have unique genetic components.

Montane Willow Riparian Forest type has a low departure from reference conditions with a static trend or slow trend toward reference conditions except in the Fern Mountain Botanical Area and portions of East Clear Creek and its tributaries. In these portions, there is a high departure from reference conditions with a static trend, primarily due to excessive elk use and/or excessive livestock grazing, nonpoint sources of sediment from roads, and in the Fern Mountain area, water diversions to private land (table 7). Invasive non-native plants threatened the regeneration potential of native species in some portions of this riparian forest type.

Table 7. Riparian forest condition, departure, and trend on forest-administrated land

Riparian Forest Type	Acres on the Forest	Percent of Forest	PFC (Miles)[a]	Functional-at-Risk (Miles)	Nonfunctional (Miles)	Unknown (Miles)	Percent of Area Miles Departed from Reference Condition[b]	Riparian Functional Condition Departure[c]	Projected Trend Current Management
Cottonwood Willow Riparian Forest	1,324	0.1%	24.2	17.9	0.5	1.8	43	Moderate	Majority is slowly toward desired conditions except portions of the Verde River and Towel Creek are mostly slowly toward. Some portions of Verde River, Dry Beaver Creek, and Lower Oak Creek are static with high recreation and private land.
Mixed Broadleaf Deciduous Riparian Forest	5,926	0.3%	134.7	55.0	4.7	25.1	31	Low	Majority is slowly toward except portions of Fossil Creek, and some of Wet Beaver Creek, which are static to away where recreation impacts occur.
Montane Willow Riparian Forest	3,568	0.2%	185.2	57.9	18.8	4.6	29	Low	Slowly toward to static except portions of Upper Clear Creek 5th HUC in East Clear Creek and its tributaries and Fern Mtn Botanical Area, which has a high departure and a static trend.
Gallery Coniferous Riparian Forest[d]	200	<0.1%	2.5	0	0	Unknown	Undocumented but assumed to be low	Low	Static

[a] All values are approximate. Note that some segments of riparian PFC mapped were outside of riparian forest polygons and therefore, total miles of 528 is less than the overall Forest RASES stream layer of about 667 miles. However, values are reliable enough to interpret wide ranges of riparian functional condition departure. Gallery Coniferous Forest reaches are generally located in riparian areas not easily accessible to humans, elk, or permitted livestock and are therefore inferred to be without those associated disturbances and likely at PFC and static trend.

[b] This represents the percentage of total known surveyed miles not in PFC, not including miles classified as unknown.

[c] Riparian and wetland condition is considered highly departed from reference conditions when 66 percent or more of inventoried riparian areas are Functioning-at-risk or Non-Functional. Low departure is when less than 33 percent of inventoried riparian areas are functional-at-risk or nonfunctional. Moderate is between low and high.

[d] Updated riparian mapping indicates that Gallery Coniferous Riparian Forest does not occur on the forest. The areas formerly classified as Gallery Coniferous (upper end of West Fork and Jack's Canyon for example) more likely fall under the Mixed Broadleaf Deciduous or Montane Willow Riparian Forest types, but this would be decided at the project level.

Existing trend from reference to current under the current plan for all stream system riparian is slowly toward desired conditions or static in some watersheds.

Wetlands

Wetlands are one of the riparian ERUs. They are areas that are inundated by surface or groundwater with a frequency to support vegetation or aquatic species that require saturated or seasonally saturated soil conditions i.e. hydric soils for growth and reproduction. Wetlands include marshes, potholes, wet meadows, and natural ponds on the Coconino NF. Standing water and vegetation in wetlands can fluctuate greatly—from basically nonexistent in dry periods to being abundant in wet periods. Hydric soils, decomposition, nutrient cycling and topography contribute to unique vegetation components and functioning wetlands. Vegetation is generally herbaceous and includes sedges, bulrush, cattails, spikerush, various grasses, and submerged aquatic vegetation.

On the Coconino NF, there are about 78 identified wetlands (10,121 acres) that primarily occur at elevations ranging from 6,200 to 7,200 feet. There are several wetland types that differ based on water permanency, vegetation, and flooding frequency: semi-permanent, seasonal, temporary, and ephemeral. The majority of wetlands are south of Flagstaff. They range in size from Mormon Lake at about 5,500 acres to less than 10 acres in size; however, most wetlands on the forest are relatively small. Stoneman Lake and Mormon Lake are the two largest wetlands and the two largest natural lakes on the forest.

Primary natural disturbances are drought, flooding, or high water levels.

Threats to wetlands include excessive wildlife herbivory, managed grazing, invasive species, and dispersed recreation in localized areas. Some wetlands are recovering from a legacy of off-highway vehicle use. Some of these disturbances can result in the lowering of water tables, which can lead to the loss of wetlands.

Wetland riparian conditions range from fair to good. The trend varies depending on the degree of protection from disturbance. Wetlands that trend toward reference conditions are typically fenced from livestock and wildlife and have few human-related impacts. Wetlands that slowly trend toward reference conditions could be fenced, but have a water gap that allows partial wildlife and livestock access to water; and are protected from most human-related impacts. An example of wetlands that have a static trend relative to reference conditions would be those that exclude only livestock, but not wildlife and few or no human-related impacts have been addressed. Trends may also be influenced by adjustments to the length or intensity of livestock grazing.

Springs and Seeps

Springs are where groundwater reaches and usually flows from the surface in complex, and sometimes lengthy, paths. Springs include seeps (low volume springs) and cienegas (marshy or wet meadow springs often with indistinct or multiple sources (e.g., Buck Springs on the Mogollon Rim Ranger District)). Springs are located in the Middle Little Colorado River, Canyon Diablo, Lower Little Colorado River, Upper Verde River, and Lower Verde River 5th code watersheds. There are at least 300 springs on the forest.

Many springs have been developed for domestic use and have been modified with earthen stock tanks, dams, pipes, cement troughs, or other structures that were constructed many years ago. These structures have altered vegetation composition and structure, spring function, and soil condition because water persistence and depth has changed These structures can also divert spring flow from

their natural area of discharge to other areas of the landscape. They may be fenced or unfenced. Some springs are in remote locations or are inaccessible.

Springs often are isolated and many serve as paleorefugia, that is, long-term stable habitats in which natural selection, isolation, and adaptation (sometimes to extreme environmental conditions) result in restricted or endemic species, such as snails, plants, and invertebrates (Stevens and Meretsky 2008). Springs may be intermittent or perennial, and water chemistry may be unique (e.g., Fossil Springs). Not all springs have hydric soils (e.g., hanging gardens) because soil development depends on the type of spring discharge.

Spring vegetation can include algae, aquatic plants, and riparian-dependent grasses, forbs, sedges, shrubs, and deciduous trees. Springs may be used for domestic use, by wildlife and/or livestock and for recreation. All springs are significant to tribes who have traditionally used lands within the Coconino NF.

Spring conditions on the forest vary depending on the degree of modification, degree of protection (e.g., fencing, and accessibility). Highly modified accessible and unfenced springs are assumed to be highly departed from reference conditions with a static trend and are classified as either nonfunctional or functional-at-risk. Inaccessible springs or fenced springs with few to no modifications are assumed to be properly functioning with a static trend. Springs whose modifications, access, and protections lie between these two are assumed to be functional-at-risk with a static trend. However, where information has been collected, a majority of unfenced springs and springs that Some springs are recovering from off-highway vehicle use in the past.

Threats vary by location except for drought. Threats include excessive wildlife herbivory, dispersed recreation, ground water pumping, and excessive livestock grazing in localized areas. Groundwater pumping can lower the water table and reduce spring flow, however, it is outside of Forest Service authority to control. Springs are also threatened by fire exclusion in fire-adapted ERUs in their associated watersheds. Fire exclusion has altered the structure in forest and woodland ERUs such that they are more vulnerable to uncharacteristic fire. Precipitation following an uncharacteristic fire can result in accelerated erosion and sedimentation into spring ecosystems negatively impacting spring function and species composition. Fire exclusion can also alter ground water recharge of the perched aquifers associated with some springs. It does this because excluding natural fires facilitates dense trees and more tree canopy which can intercept infiltration of precipitation into groundwater, which replenishes perched aquifers.

Environmental Consequences

Streams and Riparian Forest Types

Common to All Alternatives

The concept of filter strips in alternative A (1987 Plan, pages 71 to 72, 176) is replaced with the newer concept of aquatic management zones in alternative B (modified) (FW-BioPhys-Geo-G-8, FW-Water-Management Approaches, FW-Rip-All-G-3, FW-Rip-All-Management Approaches, FW-Rip-Strm-G-2, FW-Rip-Strm-Management Approaches, FW-RdsFac-G-5). Filter strips and aquatic management zones are best management practices that are applied to ground-disturbing management activities that can impact soils, water quality, and riparian vegetation near streams. All alternatives would manage filter strips or aquatic management zones for this purpose, which should result reduced sedimentation, soil compaction, and loss of vegetative cover.

Alternative A

Under alternative A, management of riparian resources would continue in accordance with direction in the 1987 plan (as amended). Direction under alternative A generally does not distinguish between the different riparian forest types. Continuing implementation of alternative A would slowly move a small percentage of these riparian areas to the desired condition of properly functioning, resilient riparian areas. Table 8 summarizes riparian function departure and trends by riparian forest type and alternative and shows where there are localized differences in the overall determination.

Table 8. Summary of stream riparian function departure values and trends

Riparian Forest Type	Forest Acres	Percent of Forest	Existing Riparian Function Departure Percent/Trend	Alternative A Riparian Function Departure Percent/Trend	Alternatives B (modified) and D Riparian Function Departure Percent/Trend	Alternative C Riparian Function Departure Percent/ Trend
Cottonwood Willow Riparian Forest	1,324	0.1	Moderate (43%)/ Slowly Toward	Moderate / Slowly Toward except some portions of Dry Beaver and Spring Creek.	Low/Slowly Toward	
Verde River, Towel Creek			Mostly Moderate/Slowly Toward. Some portions of Verde River Static (Childs, private lands, recreation impacts)	Mostly Moderate/ Slowly Toward. Some portions static (Childs, private land, recreation impacts).	Low/Toward	
Spring Creek, Dry Beaver Creek			Moderate/ Static	Moderate/ Static	Low/Toward	
Mixed Broadleaf Riparian Forest	5,926	0.3	Low (30%)/ Static to Slowly Toward	Low/Static to Slowly Toward	Low (<33%) except portions Wet Beaver high impacts.	Slowly Toward of Fossil Creek, Creek due to recreational
Beaver Creek 5th code HUC			Moderate (39%)/ Slowly Toward	Moderate/ Slowly Toward	Low but recreation / Toward	Moderate in impacted areas
Oak Creek 5th code HUC			Low-Moderate (33%)/ Static	Low-Moderate/Static	Low/Toward	
West Clear Creek 5th code HUC			Low/Static	Low/Static	Low/Slowly Toward	
Fossil Creek Lower Verde River 5th code HUC			Low (27%)/Slowly Toward but departed and away on recreation areas on Fossil Creek	Low/Slowly Toward but Away on recreation impacted areas (Fossil Creek middle reach)	Low/Toward	

Riparian Forest Type	Forest Acres	Percent of Forest	Existing Riparian Function Departure Percent/Trend	Alternative A Riparian Function Departure Percent/Trend	Alternatives B (modified) and D Riparian Function Departure Percent/Trend	Alternative C Riparian Function Departure Percent/ Trend
Montane Willow Riparian Forest	3,568	0.2	Low (29%)/ Slowly Toward	Low (<29%) Static to Slowly Toward		
East Clear Creek in Upper Clear Creek 5th code HUC and Fern Mt. Botanical Area			High / Static	Moderate/ Toward	Low/ Toward	

*Departure was assessed as low (0 to 33 percent), moderate (34 to 66 percent), or high (greater than 66 percent)

The current plan has standards and guidelines that maintain at least 80 percent of potential overstory crown cover, 80 percent of the potential shrub cover in high elevation areas, 80 percent of the fish spawning gravel surface free of inorganic sediment, 80 percent of stream bank total linear distance in stable condition (1987 Plan, page 72, 174), and 80 percent emergent vegetation cover from May 1 to July 15 in key wetlands (1987 Plan, page 174); and maintain three age classes of woody riparian species (1987 Plan, page 174). These would mitigate accelerated erosion and decrease sedimentation into connected waters from roads, trails, or activities that occur within or near riparian areas; help maintain the water table, and contribute to the proper function of stream ecosystems.

Alternative A would maintain and protect streams and the associated riparian zone via plan language that directs managers to construct fences where necessary to protect key wet meadows, wetlands, and riparian regeneration from grazing and to provide livestock and wildlife waters away from riparian communities (1987 Plan, page 175). Other standards and guidelines would protect streamcourses by reminding managers to prioritize road closures where poorly designed or maintained roads are adjacent to or connected to streamcourses where potential for increased runoff or sedimentation is high and where roads within streamcourses or wetlands (permanently or intermittently wet) are reducing hydrologic function would maintain hydrologic function (1987 Plan, page 206-71).

The Riparian and Open Waters Management Area (MA 12) provides the primary direction for managing and protecting riparian features and functions (1987 Plan, page 171 to 177). While most of the direction in this section supports properly functioning riparian forests, riparian improvement is hindered by standards and guidelines in MA 12 that prohibit precommercial thinning in riparian areas or areas with riparian characteristics (1987 Plan, page 176). Precommercial thinning is a silvicultural tool used to remove young conifers that would otherwise increase the risk of uncharacteristically severe fire effects and move understory conditions away from desired conditions.

Under alternative A, plan direction includes fire suppression objectives (1987 Plan, pages 93 to 94) and language that makes it difficult to implement the reintroduction of fire as a natural disturbance across a large part of the forest. Fire exclusion in adjoining upland vegetation types increases the risk for uncharacteristic fire behavior and undesirable effects in riparian corridors. Uncharacteristic fire could kill riparian vegetation, facilitate establishment of invasive exotic plants, and potentially dry riparian areas through channel incision.

There is additional language to fight fire aggressively to prevent resource damage using suppression methods that minimize long-term adverse impacts to riparian habitats (1987 Plan, page 177).

Livestock grazing would be managed to contribute toward satisfactory riparian conditions through amended allotment management plans if needed; using salt to achieve proper livestock grazing distribution, and having allowable use in riparian areas not to exceed 20 percent (1987 Plan, page 175). Riparian condition and nutrient cycling are expected to improve with the forestwide allowable use guidelines for livestock grazing (1987 Plan, page 66-1). These guidelines are intended to be used when site-specific information is not available, to maintain sufficient vegetative ground cover to sustain soil productivity. Projected future litter and vegetation conditions, which affect nutrient cycling and carbon sequestration, should improve and approach sustainable levels under the 1987 plan grazing guidelines, as long as allowable use levels in the plan are met.

Riparian zones and streams would also be maintained or protected via standards and guidelines that would allow mineral material excavation within the riparian zone after environmental analysis has been completed and authorized mineral activities would maintain or improve riparian conditions (1987 Plan, page 177).

The overall trend for riparian functional condition in alternative A is static (no change), slowly toward desired conditions, or toward desired conditions except for heavily used areas in the middle reach of Fossil Creek. The trend is away from desired conditions in this area. The trend on some portions of stream riparian areas would remain static due to high levels of recreation impacts including dispersed camping, high levels of ungulate herbivory (elk and livestock) and lack of specific forest plan guidance including objectives and desired conditions of proper functioning riparian areas.

Alternative B (modified)

Alternative B (modified) would improve the condition of streams and riparian forest types toward desired conditions at the same rate as alternative A. However, plan language in alternative B (modified) would result in improvements in localized areas more effectively than alternative A.

Alternative B (modified) has specific objectives to restore function to 200 to 500 acres of nonfunctional and functional-at-risk riparian areas during each 10-year period over the life of the plan and to restore or enhance at least 70 miles of stream habitat during each 10-year period over the life of the plan (FW-WFP-O-4, FW-Rip-RipType-O-1). The low end of the range on the restoration of riparian areas would restore about 5 percent of departed riparian forest types and the high end of the range would restore about 15 percent of departed riparian forest types. Although alternative A also promotes restoration of riparian areas, this plan objective is more realistically accomplished than alternative A and it would improve overall function and resiliency of riparian areas. Riparian vegetation would improve along streambanks, aiding in the ability to filter sediments; capture bedload and aid floodplain development; improve floodwater retention and groundwater recharge; develop root masses that stabilize streambanks against cutting action; and dissipate stream energy associated with high water flow, thereby reducing erosion and improving water quality.

A guideline would improve riparian function in localized areas that have soil compaction, water quality concerns, and vegetation damage from dispersed recreation. This guideline would manage dispersed camping along riparian areas to maintain desired conditions for riparian areas and water (FW-Rec-Disp-G-5). Other guidelines manage activities in a manner that would lead to improvement of riparian function in specific areas, such as:

- Prohibiting horse and pack stock on the West Fork of Oak Creek Trail (MA-OakCrk-S-6).

- Locate and manage trails and recreation to reduce impacts to woody riparian vegetation and riparian habitat (MA-OakCrk-G-5).

- Recreation should be managed to maintain water quality standards by placing toilets in strategic locations, providing information about proper sanitation practices, installing shower and hand-washing facilities, and providing gray water disposal sites (MA-OakCrk-G-9).

- Vehicular access to Oak Creek should be restricted by measures, such as vehicle barriers, to minimize user conflicts, to maintain the desired conditions of other resources, and to promote public health and safety (MA-SedN-G-5).

- Projects and activities (in the Verde Valley Management Area) should be designed and implemented to maintain or improve watershed and riparian function and/or prevent the introduction or spread of disease, invasive, or undesirable species (MA-VerdeV-G-1).

- Dispersed camping opportunities and motorized recreation(in the Long Valley Management Area) should be managed to occur outside the vicinity of meadows and riparian areas to maintain soil function, long-term soil productivity, and desired conditions for associated resources (MA-LongV-G-1, MA-EastClr-G-1).

- The C.C. Cragin Watersheds Management Area should be managed to reduce the threat of uncharacteristic wildfires, flooding, and sedimentation, and to maintain water quality and quantity (MA-CCCrg-G-2).

- In the Fossil Creek Wilderness, projects and activities should be designed to maintain the travertine formations and water chemistry of Fossil Creek (SA-Wild-G-8).

- Recreation and other activities at designated and eligible rivers and associated corridors should be managed to occur at appropriate locations and intensities to protect and enhance the free-flowing condition, and the outstandingly remarkable values, consistent with the classification (SA-WSR-G-1).

- Components from approved comprehensive river management plans (desired conditions, standards, guidelines, and monitoring) should be applied to activities occurring within the established river corridor boundary to protect and enhance water quality and outstandingly remarkable values, and protect the free-flowing character of the wild and scenic river (SA-WSR-G-2).

Other differences between plan direction in alternative A and alternative B (modified) are the updated and more accurately defined desired conditions for managing for riparian function, natural disturbances, and water quality (FW-Rip-RipType-DC-1 and 4), vegetative diversity, cover, and structure (FW-RipType-DC-2, 3, 5 and 6). In addition, a desired condition promotes reducing riparian fragmentation and improving habitat connectivity (FW-Rip-All-DC-3).

As a result of this plan direction, some positive trend is expected along with reducing riparian fragmentation and the threat of excessive sedimentation. Implementing plan direction for soil and water resource improvement projects prescribed in alternative B (modified) would result in improved soil condition and reduced threat of high-severity fires that might threaten riparian function and water quality. This clearer direction on how to actively restore functional-at-risk and nonfunctional riparian types is more likely to result in restoring more of these areas to proper functioning condition than would occur under alternative A.

A desired condition in alternative B (modified) for all riparian forest types states, "… Periodic flooding and scouring are the primary natural disturbances and promote a diverse plant structure consisting of herbaceous, shrub, and tree species of all ages and size classes necessary for the recruitment and succession of riparian dependent species. Age and size classes include seedling, sapling, mature, and overmature vegetation.…" (FW-Rip-RipType-DC-1). This desired condition would move terrestrial ERUs adjacent to riparian forests types toward desired conditions and closer to their natural fire or disturbance regimes. In contrast to alternative A, plan language would remove restrictions to using wildfires for resource objectives in wilderness and wildland urban interface(Vegetation and Fire specialist report, USDA Forest Service 2016c). As a result, the landscape-scale risk of uncharacteristic fire to riparian forest types would be less under alternative B (modified) than under alternative A, depending on where fire risk reduction or restoration treatments occurred.

Alternative B (modified) recommends three wilderness areas. The recommendation of wilderness areas in alternative B (modified) is not expected to better protect streams and riparian resources primarily because of the small amount of water and riparian vegetation in these areas. The Abineau and Strawberry recommended wildernesses have no water or riparian vegetation and the Davey's recommended wilderness has a low amount of perennial water and only 21 acres of Mixed Broadleaf Deciduous Riparian Forest. This represents about 0.5 percent of that riparian forest type. There are few current impacts to water and riparian resources in the Davey's recommended wilderness area. Therefore, water quality and riparian function would not differ from alternative A.

Alternative B (modified) would include a determination that mechanized recreation is suitable on designated trails in botanical and geological areas. There are 88 acres of riparian forest types in designated botanical and geological areas in this alternative which less than 1 percent of the riparian forest types on the forest. Mechanized recreation on designated trails would not affect riparian condition at the landscape level because of this small percentage. There could be localized effects including soil compaction, accelerated soil erosion, and vegetation loss or damage. Additionally, it is unlikely trails would be designated within aquatic management zones, and best management practices would be followed under all alternatives. Alternative B (modified) could result in fewer localized effects than alternative A, which does not include suitability determinations for mechanized travel. This could lead to mechanized use anywhere in a botanical and geological area as long as the use does not conflict with the purpose of the area.

Alternative C

Alternative C has the same effects as alternative B (modified) except for the following.

Alternative C recommends thirteen wilderness areas. Recommendation of new wilderness areas in alternative C could indirectly protect streams and riparian areas within portions of the Barbershop, Black Mountain, Cedar Bench, East Clear Creek, Davey's, Walker Creek, and Hackberry recommended wilderness areas better than alternative A. The recommended wilderness areas in alternative C would include about 1,300 acres of riparian forest, which is about 12 percent of the total riparian forest acreage on the Coconino NF. Some riparian forest acreage is hard to access and has little human disturbance while other areas are more accessible to recreation. In areas of limited access, streams and riparian forest types are not expected to be better protected under wilderness recommendation, but in accessible areas, streams and riparian forest types could be better protected in a recommended wilderness because plan direction would promote activities and structures to be consistent with wilderness character (e.g., structures, new trails, etc.) (SA-RWild-DC-1, 2, 5, 6, and G-1, 2, 3, 4, and 5). The recommendation of new wilderness areas in alternative C is not expected to

offer additional protection or reduced human disturbance to streams and riparian forests at the landscape level but would improve protection in localized areas.

Alternative C restricts grazing in research natural areas unless it supports or would not affect the research purpose of the research natural area (Appendix F, SA-RNABotGeo-G-4). However, this restriction does little to change the effects to current and proposed research natural areas among alternatives, because little to no grazing occurs in these areas under current management.

Alternative C would include a determination that mechanized recreation is not suitable in botanical and geological areas. With this plan guidance in place, future site-specific decisions may restrict mechanized travel in these areas, even on designated trails. These restrictions would result in fewer localized effects than alternative B (modified), which includes a determination that mechanized travel is not suitable except on designated trails.

Alternative C also recommends that portions of the forest are not suitable for recreational shooting. Shooting is not a ground-disturbing activity and would not impact riparian function, but it does have potential to result in lead contamination of soils and water with concentrated use over time. Like alternative B (modified), alternative C has plan components that address the potential impacts of lead contamination to soil and water quality. These include desired conditions for soils to function properly (FW-Soil-DC-1 and 2) and for water quality to support ecological functions and meet or exceed Arizona water quality standards (FW-Water-DC-6 and 7). Alternatives B (modified) and C have management approaches for all recreation that include collaboration with the Arizona Game and Fish Department, local law enforcement, and other stakeholders to address issues and opportunities related to recreational shooting on the Coconino NF. Plan direction under alternatives B (modified) and C, therefore, provides more protection for soils resources from lead contamination than alternative A and plan direction under alternative C provides more protection for soils resources from lead contamination than alternatives A or B (modified).

Alternative C differs from the other alternatives in that certain management areas would be managed for reduced human-related disturbance to wildlife habitat. These eight management areas (Anderson Mesa, Blue Ridge, Jack's Canyon, Pine Grove, Hospital Ridge, Knoll Lake, Second Chance, Limestone Pasture) include guidelines that provide for no net increase in the area of motorized dispersed camping corridors designated, reduce public motor vehicle access, and generally prohibit large group recreation events and large commercial tours, except in developed site. Implementation of these guidelines could better protect streams and riparian areas from soil compaction, accelerated soil erosion, and vegetation damage associated with dispersed camping corridors, public motorized use, and large group events depending on certain variables.

Alternative D

Alternative D would have the same effects as alternative B (modified), except alternative D does not recommend any new wilderness areas. The effects associated with the recommendation of those 8,733 acres under alternative B (modified) would not occur under alternative D.

Wetlands

Alternative A

Although alternative A lacks specific objectives for wetlands restoration, it has not precluded wetlands improvement and restoration on the forest. Table 9 summarizes how plan components influence departure and trend toward desired conditions among the alternatives and shows that alternative A is trending toward desired conditions.

Table 9. Summary of departure values and trend by alternative for wetlands

Riparian Area	Amount on Forest	Existing Riparian Departure Percent/Trend	Alternative A Riparian Departure Percent/Trend	Alternatives B (modified), C, D Riparian Departure Percent/Trend
Wetland	78 wetlands, 10,121 acres	By number: Moderate (44%)/Toward reference conditions; By acres: Low (8%)/Toward reference conditions	By number: Moderate (44%)/Toward desired conditions; By acres: Low/toward desired conditions	By number: Low (19%)/Toward desired conditions; By acres: Low/Toward desired conditions

Wetland management would continue in accordance with direction in the 1987 plan (as amended). Alternative A would emphasize wildlife habitat, visual quality, fish habitat, and watershed condition in wetlands. This alternative would also emphasize the riparian vegetation which is important for filtering sediments generated from upslope erosion. The current plan would improve riparian areas through a combination of projects and management activities and it is expected that 80 percent of the riparian recovery would occur by 2030 (1987 Plan, page 172). Alternative A would mitigate recreation impacts to Stoneman Lake, one of the largest natural lakes on the Coconino NF and in Arizona, by managing its basin for dispersed day use and prohibiting overnight camping in the basin (1987 Plan, page 173). Riparian condition would be improved or protected by vegetation projects, special management prescriptions, and fencing out livestock (1987 Plan, page 174). Improvements would include fence construction, providing waters for wildlife and livestock away from sensitive areas; avoidance of salt within a quarter mile of the edge of any riparian area; fencing Stoneman Lake to exclude livestock grazing below the rim of the basin; avoidance of slash or precommercial thinning in riparian areas; prohibition of new special uses in riparian areas unless they benefit riparian management; acquisition of riparian areas through land exchange; and aggressive fire suppression to prevent resource damage using methods that minimize long-term adverse impacts to riparian habitats (1987 Plan, pages 175, 176, and 177). These improvements would help maintain hydrologic function and nutrient cycling, prevent soil compaction, and maintain species diversity.

Alternative A promotes various methods to control livestock distribution and mitigate livestock impacts to different resources including wetlands. These methods include using cattleguards, waterlots, and salt; controlling livestock grazing through management and/or fencing to establish vegetation and eliminate overuse; and managing seeding projects to avoid concentrating livestock use in riparian and other sensitive areas (1987 Plan, pages 68 and 69). Other plan components emphasize rehabilitation of high elevation riparian communities through grazing management, fencing, road relocation, recreation management, and physical protection of revegetation work (1987 Plan, page 206-78). These methods would also help maintain hydrologic function and nutrient cycling, prevent soil compaction, and maintain vegetative species diversity and vigor.

Finally, alternative A also promotes constructing 150 waterfowl islands and creating potholes in wetland areas to provide nesting habitat (1987 Plan, page 175). Depending on site-specific circumstances, these structures would have no or little impact to wetlands. or could alter vegetation composition and structure, wetland function, and soil condition because water persistence and depth would change.

Alternatives B (modified), C, and D

Wetlands are currently at a moderate level of vegetative departure with a static trend toward desired conditions. Herbivory in unprotected areas could lead to a shift toward earlier successional species and shorter vegetative structure. Unlike alternative A, alternatives B (modified), C, and D have an

objective to restore 5 to 10 wetlands per decade to a properly functioning condition (FW-Rip-Wtlnds-O-1), which establishes a goal for restoration of wetlands.

Alternatives B (modified), C, and D include plan components that would move wetlands toward identified desired conditions and reduce the departure. Desired conditions specify that: (1) wetlands provide functional soil and water resources in most areas and trending toward proper functioning condition (FW-Rip-Wtlnds-DC-1), and (2) wetland vegetation has diverse age classes, diverse composition and includes vegetation that indicates maintenance of soil moisture (FW-Rip-Wtlnds-DC-2).

Springs

Alternative A

Management of springs would continue in accordance with direction in the 1987 plan (as amended). Although alternative A lacks specific objectives for springs restoration, it has not precluded spring improvement and restoration on the forest. Table 10 summarizes how plan components influence departure and trend toward desired conditions among the alternatives and shows that alternative A is trending toward desired conditions.

Table 10. Summary of departure values and trend by alternative for springs

Amount on Forest	Existing Spring Departure /Trend	Alternative A Spring Departure /Trend	Alternatives B (modified), C, D Spring Departure /Trend
Over 300	High for accessible unfenced springs. Low for fenced springs or those with poor access. Slowly toward reference conditions	High for accessible unfenced springs Static Low for fenced, improved, or protected springs or undeveloped springs with poor access. Toward desired conditions	High for accessible unfenced springs Static Low for fenced, improved, or protected springs or undeveloped springs with poor access. Toward desired conditions

This alternative would also emphasize the riparian vegetation which is important for filtering sediments generated from upslope erosion. The current plan would improve riparian areas through a combination of projects and management activities and it is expected that 80 percent of the riparian recovery would occur by 2030 (1987 Plan, page 172). Riparian condition would be improved or protected by vegetation projects, special management prescriptions, and fencing out livestock (1987 Plan, page 174). Improvements would include fence construction, providing waters for wildlife and livestock away from sensitive areas; avoidance of salt within a quarter mile of the edge of any riparian area; avoidance of slash or precommercial thinning in riparian areas; prohibition of new special uses in riparian areas unless they benefit riparian management; acquisition of riparian areas through land exchange; and aggressive fire suppression to prevent resource damage using methods that minimize long-term adverse impacts to riparian habitats (1987 Plan, pages 175, 176, and 177). These improvements would help maintain hydrologic function and nutrient cycling, prevent soil compaction, and maintain species diversity.

Alternative A promotes various methods to control livestock distribution and mitigate livestock impacts to different resources including springs. These methods include using cattleguards, waterlots, and salt; controlling livestock grazing through management and/or fencing to establish vegetation and eliminate overuse; and managing seeding projects to avoid concentrating livestock use in riparian and other sensitive areas (1987 Plan, pages 68 and 69). Other plan components for the Flagstaff Lake Mary Ecosystem Area emphasize rehabilitation of high elevation riparian

communities through grazing management, fencing, road relocation, recreation management, and physical protection of revegetation work (1987 Plan, page 206-78). These methods would also help maintain hydrologic function and nutrient cycling, prevent soil compaction, and maintain vegetative species diversity and vigor.

Alternative B (modified)

Unlike alternative A, alternative B (modified) has desired conditions specifically for springs. The desired conditions that are listed below provide for spring functionality consistent with natural processes; spring composition and structure; spring processes, groundwater recharge, base flow, connectivity, development, and habitat for species that are narrowly endemic and those with restricted distributions.

- Springs have functional soil, water, and vegetative resources consistent with natural waterflow patterns, recharge rates, and geochemistry appropriate for the site (FW-Rip-Spr-DC-1).
- Spring vegetation has young, mid, and late seral stages and a composition of native aquatic and riparian species consistent with spring type, slope, aspect, natural disturbances, and natural solar energy budget (amount of radiation during different times of the year4F[20] (FW-Rip-Spr-DC-2).
- Spring riparian zones are capable of filtering sediment, capturing and/or transporting bedload, improving or maintaining water quality, providing groundwater recharge and supporting perched water-bearing zones within their natural potential, consistent with the spring type (FW-Rip-Spr-DC-3).
- Consistent with existing water rights and claims, springs are rarely developed and altered by human-made structures such as head boxes, cisterns, and pipelines (FW-Rip-Spr-DC-4).
- The physical and biological components of springs provide habitat for narrowly endemic species and those with restricted distributions (FW-Rip-Spr-DC-5).
- Riparian areas exhibit connectivity between and within aquatic, riparian and upland components that reflects their natural range of variability and linkages. Naturally isolated springs remain isolated. Riparian areas are connected vertically between surface and subsurface flows. Streamcourses and other links between aquatic and upland components support ecological functions, and provide habitat and movement corridors for aquatic and upland species (FW-Rip-All-DC-3).
- Ecosystems and ecological resources within wilderness are functioning properly and reflect natural processes. Unique features are preserved, such as the scarp of the Mogollon Rim and the travertine in the Fossil Springs Wilderness Area, and hanging gardens in the West Clear Creek Wilderness Area (SA-Wild-DC-2).

Unlike alternative A, alternative B (modified) has an objective to restore riparian function to at least 25 springs not in PFC every 10 years to provide water quantity and aquatic habitat for the recovery of plant and animal species (FW-Rip-Spr-O-1), which establishes a goal for spring restoration and improvement for managers.

This alternative includes the guidelines listed below, which are designed to maintain or improve spring discharge, water quantity, soil and riparian function, and native vegetation. There are also guidelines that would address threats to spring ecosystem components by preventing the introduction or spread of disease, invasive, or undesirable species. In addition, guidelines would prioritize the

[20] The number of species and the number of endemic species are correlated with solar energy.

protection of spring sources and riparian habitat which are associated with important ecological and biophysical characteristics and cultural values.

- Spring recharge areas, where known, should be managed to maintain or improve spring discharge (FW-Rip-Spr-G-1, MA-InBsn-G-1).
- Water rights should be maintained or procured to protect in situ (onsite) water quantity where no water rights exist (FW-Rip-Spr-G-2).
- Projects and activities should be designed and implemented to maintain or improve soil and riparian function; maintain or improve native vegetation; and/or prevent the introduction or spread of disease, invasive, or undesirable species. Design features could include road, recreation, and/or livestock management(FW-Rip-Spr-G-3, MA-InBsn-G-2).
- Where there is a structure in place to use water from a spring as a water source or when designing restoration projects, priority should be given to the protection of spring source areas and riparian habitat to safeguard the unique ecological and biophysical characteristics, higher biodiversity, endemic species, and cultural values associated with spring sources. For example, water could be piped out of the riparian area to avoid negative impacts to soil, water, and vegetation or if water is to be diverted, a flow-splitter could be installed to maintain some flow at the source (FW-Rip-Spr-G-4, MA-InBsn-G-3).
- Within existing water rights, excess water should remain in or be allowed to flow freely back into the natural channel, spring, and riparian habitat to maintain and improve ecological function, water quality, quantity, and timing of flows, and to benefit native species and their habitat (FW-Water-G-6).

This alternative also includes guidance related to springs in the direction for other resource areas. Permitted livestock grazing is consistent with the desired conditions of other resources. However, conditions immediately adjacent to livestock concentration areas, such as earthen stock ponds, developed springs, and other features that concentrate livestock, may be inconsistent with general desired conditions for vegetation and soil such as lower levels of vegetation and higher levels of soil compaction (FW-Graz-G-2). The extent and the magnitude of the effect to spring conditions cannot be determined at the plan because the effect would be dependent on site-specific circumstances such as degree of development, spring condition, and frequency and intensity of grazing. This would need to be worked out at the allotment specific level on the district.

Another guideline included in this alternative requires the use of best management practices to protect water quality and to avoid springs during road construction and relocation (FW-RdsFac-G-5). This would reduce soil compaction, loss of riparian vegetation cover, prevent accessway in close proximity to springs, prevent damage to spring runout channels, and maintain water quality.

The section on Special Uses has a guideline that would limit the issuance of lands and recreation special use permits beyond a 200-foot distance from perennial streams, springs, or waters that contribute to or support sensitive resources such as federally listed or Southwestern Region sensitive species. The intent is to protect riparian resources. Exceptions may be made for hardened or slickrock sites, water-dependent activities, or safety (FW-SpecUse-G-3). This guideline would eliminate encroachment of human activities and facilities on spring ecosystems and result in fewer human-related impacts on these ecosystems.

Another guideline would protect springs from recreational activities that could compromise water quality and soil and riparian condition in Sycamore Canyon designated wilderness (SA-Wild-G-11).

Alternative B (modified) recommends three wilderness areas (Abineau, Strawberry Crater extension, and Davey's), totaling 8,733 acres. There is one known spring in Davey's RWA. Plan components would promote the maintenance or protection of springs and their associated riparian area (soil, water quantity and quality, species) by preserving native species and unique features and promoting ecological systems free of human-related development, including spring water capture and diversion (SA-RWild-DC-2 and 3). Undeveloped springs and natural spring processes would be favored due to a desired condition that promotes little evidence of structures, construction, and other signs of modern human presence (SA-RWild-DC-5). Plan components do not preclude the removal of infrastructure associated with spring development or other unneeded infrastructure but removal could be challenging if motorized vehicle use or access is limited. If recommended wilderness becomes designated, these challenges would become greater because motorized and mechanized use is prohibited in designated wilderness.

Alternative B (modified) recommends the Cottonwood Geological and Botanical Area in which there are two springs. Alternative B (modified) would better protect the two springs than alternatives A and D because allotment management plans would contain special provisions to protect the unique qualities of this area and access would be limited to foot traffic to also protect the unique features of this area (SA-RNABotGeo-G-1, 4, and 7). Additionally human activities, permitted uses and types and levels of access would be managed to protect the ecological conditions, including springs, of this area. These protections would eliminate or mitigate sedimentation, soil compaction, and damage to and loss of vegetative cover that can occur with human activities and permitted uses.

Alternative B (modified) has the following management approach: Continue working with partners and stakeholders, including tribes, to inventory, classify, assess, and prioritize springs and recharge areas for restoration, and to implement restoration activities. Include consideration of rare species and endemic species when evaluating springs for restoration. This reminds managers to collaborate and coordinate with interested and affected parties especially when springs can have contributions and values that go beyond the immediate area.

Alternative C

Alternative C would have the same effects as alternative B (modified) except the impact on springs from wilderness recommendation is greater than alternative B (modified) because 13 wilderness areas, totaling 91,757 acres, are recommended. There would therefore be many more springs in recommended wildernesses affected by the plan components related to recommended wilderness.

Alternative D

Alternative D would have the same effects as alternative B (modified) except alternative D does not recommend any new wilderness areas and it includes designation of the 185-acre Cottonwood Basin Geological Area only with no designation of the Botanical Area as in alternatives B (modified) and C. In addition, alternative D is the same as alternative A, which recommends no new or additions to wilderness areas. Therefore, the additional management and resulting effects associated with 8,733 acres of recommended wilderness and 578 acres of Cottonwood Basin Botanical Area discussed in alternative B (modified) would not occur in these areas.

Cumulative Effects

See the cumulative effects discussion in the Watersheds and Water section above.

Soil

Soils are a physical element of the environment made up of mineral particles (e.g., sand, silt, and clay), air, water, and organic matter. Soils form by the interaction between climate, organisms,

topography, parent material, and time. Soils store water, supply nutrients for plants, and provide a medium for plant growth. Soils also provide habitat for a diverse number of below-ground organisms. Due to their slow rate of formation, soils are essentially a non-renewable resource.

This section summarizes current conditions and departures between current and reference conditions and associated trends, for soil condition, soil productivity, and biological soil crusts. Further information on soils, departure, and trend by ERU, can be found in the "Ecological Sustainability Report" (USDA Forest Service 2009a) and "Soils Specialist Report for the Ecological Sustainability Report" (USDA Forest Service 2009b).

Affected Environment

Soils of the Coconino NF have developed primarily from volcanic and sedimentary origins. Soils range from very shallow to deep, old and well-developed to recent and less developed, and occur on all slope ranges from nearly level to very steep. Elevations on the forests range from almost 12,667 feet in the San Francisco Peaks Alpine Tundra to less than 2,600 feet in the Verde Valley desert soils, which provides soil climate in upland soils ranging from cryic (cold) to thermic (hot) soil temperature regimes, and from udic (moist) to aridic (dry) soil moisture regimes. Herbage (i.e., herbaceous plant growth) productivity ranges from near 3,000 pounds per acre in the wettest areas, to less than 25 pounds per acre in the driest, raw cindery soils.

Soil Condition and Productivity

Soil condition is an evaluation of soil quality based on factors that affect vital soil functions and is based on the primary soil functions of soil hydrology, soil stability, and nutrient cycling. Soil condition is influenced by natural and human-caused factors. Human disturbances during the last 100 to 125 years are believed to have caused impacts and declines in soil condition (USDA Forest Service 2009a). Major disturbances that were absent historically include: livestock and elk herbivory (i.e., vegetation consumption), vegetative treatments, dispersed recreational and off-highway vehicle use, and establishment and use of roads and trails. Fire is a disturbance that existed historically, but is now largely absent at past frequencies and severities. Historic fire regimes maintained many portions of the Semi-desert Grassland, Pinyon Juniper with Grass, Ponderosa Pine, Mixed Conifer with Frequent Fire, and Pinyon Juniper Evergreen Shrub ERUs in more open stands with more herbaceous understory and protective litter. The Coconino NF has experienced multiple years of drought since about 1997. This has resulted in reduced upland vegetative growth and ineffective ground cover, putting the soil at risk of accelerated erosion, loss of soil productivity, and increasing sediment delivery to streams during storm events causing local water quality degradation.

Table 11 displays the current departures and trends of soil condition class from reference condition by ERU and riparian areas within lands managed by the Coconino NF.

Historically, most areas on the forest (89 percent) are inferred to have been in satisfactory[21] soil condition and about 11 percent of the areas were inherently unstable.[22] Currently, about 62 percent of the soils are in satisfactory soil condition and about 11 percent are satisfactory but inherently unstable. Inherently unstable soils are located on very steep slopes where natural erosion rates exceed tolerable rates and are eroding faster than they are renewing themselves, but are functioning properly and normally. Both condition classes are considered to meet desired and reference[23]

[21] Satisfactory: soil function is being sustained and soil is functioning properly and normally. Soil is able to recycle nutrients, infiltrate water, and resist erosion within its inherent capability. Surface litter, understory production, and species composition is similar to reference.
[22] Inherently unstable: soils are naturally eroding faster than they are renewing and are functioning normally.
[23] Reference conditions are the conditions thought to be present historically (pre-European settlement).

conditions (table 11) and these classifications indicate soil function is sustained and functioning normally and properly. The proportion of individual ERU or riparian forest type with satisfactory soils varies between 0 to about 100 percent. More than half of the ERU or riparian forest type is considered satisfactory in Mixed Broadleaf Deciduous Riparian, Montane Willow Riparian, Desert Communities, Interior Chaparral, Pinyon-Juniper with Grass, Ponderosa Pine, both mixed conifer types, Spruce-Fir, and Alpine or Tundra.

Overall, about 27 percent of the soils, are in impaired[24] (21 percent) or unsatisfactory[25] (6 percent) condition. The impaired and unsatisfactory soil are located predominantly within 6 ERUs (Desert Communities, Great Basin Grassland, montane portion of Montane Subalpine Grasslands, Pinyon-Juniper Evergreen Shrub, Pinyon-Juniper Woodland (Persistent), and Semi-desert Grassland), two riparian forests (Cottonwood Willow Riparian Forest and Mixed Broadleaf Deciduous Riparian Forest), and Wetlands (table 11). These departures indicate a reduction or loss in soil function and the possibility that they may not be able to sustain ecological functions and soil productivity. The proportion of individual ERU or riparian forest type with impaired and/or unsatisfactory soils varies from 0 to about 96 percent. More than half of the ERU or riparian forest type is considered unsatisfactory or impaired in Cottonwood Willow Riparian Forest, Semi-desert Grassland, Great Basin Grassland, Montane Subalpine Grassland, Pinyon Juniper Evergreen Shrub, Pinyon Juniper Woodland, and Wetlands (table 11).

From a landscape perspective, soils on about 67 percent of the forest are considered to have a low departure from reference conditions and most have a static trend except Pinyon Juniper with Grass ERU which is trending away from reference conditions. About 22 percent of forest soils are moderately departed and trending away from reference conditions except for Desert Communities ERU, which has a static trend. About 11 percent of forest soils are highly departed with trends that are either static, slowly toward, or toward reference conditions (table 11). Low departure signifies that less than 33 percent of the acres are in impaired or unsatisfactory condition. Moderate departure signifies that 34 to 66 percent of the acres are departed and High departure indicates that greater than 67 percent of the acres are in impaired or unsatisfactory condition.

[24] Impaired: The ability of the soil to function properly and normally is reduced and/or there is increased vulnerability to degradation. There is a reduced ability to recycle nutrients, infiltrate water, and resist erosion. Lower surface litter, lower understory production, poor species composition, more visible sheet and rill erosion compared to reference conditions.
[25] Unsatisfactory: A loss of soil function has occurred such that the soil is unable to maintain resource values, sustain outputs, or recover.

Table 11. Current departures and trends of soil condition class from reference condition by ERU or riparian areas within lands managed by the Coconino NF

ERU or Riparian Forest Type	Total Acres	Soil Condition Class				Departure[1] and Trend from Reference Condition
		Satisfactory	Satisfactory, but Inherently Unstable	Unsatisfactory	Impaired	
Cottonwood Willow Riparian Forest	1,324	1.4%	6.7%	0%	91.9%	High – slowly toward
Mixed Broadleaf Deciduous Riparian Forest	5,926	61.1%	8.3%	0.9%	29.7%	Low – static
Montane Willow Riparian Forest	3,568	79.5%	11.2%	2.6%	6.7%	Low – static
Desert Communities	62,877	0%	54.9%	7.5%	37.7%	Moderate – static
Semi-desert Grassland	89,701	0%	4.4%	24.6%	71.0%	High – slowly toward
Great Basin Grassland	92,842	13.5%	0%	41.9%	44.6%	High – slowly toward
Montane/Subalpine Grassland	23,656	31.3%	0%	0%	68.7%	High – static
Interior Chaparral	50,471	10.8%	89.2%	0%	0%	Low – static
Pinyon Juniper with Grass	261,454	67.9%	4%	10.9%	17.3%	Low – away
Pinyon Juniper Evergreen Shrub	263,554	7.7%	35.6%	0%	56.7%	Moderate – away
Pinyon Juniper Woodland (Persistent)	75,439	28.3%	12.0%	0%	59.7%	Moderate – away
Ponderosa Pine	797,171	98.6%	0%	1.4%	0%	Low – static
Mixed Conifer with Frequent Fire	49,595	99.6%	0.4%	0%	0%	Low – static
Mixed Conifer with Infrequent Fire	37,143	100%	0%	0%	0%	Low – static
Spruce-Fir Forest	13,946	91%	9%	0%	0%	Low – static
Alpine or Tundra	939	0%	100%	0%	0%	Low – static
Wetlands	10,121	10.6%	0%	52.2%	37.2%	High – static
Grand Total	1,839,727	62.0%	10.9%	5.9%	21.2%	

[1] Departure ratings from reference conditions: Low signifies 33 percent or less of the acres are in impaired or unsatisfactory condition. A moderate departure signifies a departure of 34 to 66 percent, and high departure is a difference of 67 percent or greater. All values are approximate. Grand total excludes about 3 acres of water slivers that are a result of GIS processing.

Soil productivity is a combination of soil organic matter, litter cover, and estimated understory and forage production. Soil productivity can vary widely within an ERU based on the site potential. In general, the most productive soils are within Montane Subalpine Grassland ERU and Wetlands, followed by the Great Basin Grassland ERU. These soils have high amounts of organic matter and are capable of producing the greatest amount of understory and forage. Current understory and forage productivity, however, appears to be low to moderate. In the montane grasslands portion of the Montane Subalpine Grassland ERU where impaired soils are prevalent, areas of impaired soils have reduced soil productivity and are expected to remain impaired (static) due to continued grazing, especially by elk. Trends are toward reference condition in isolated areas where grazers are excluded; however, these are in very limited areas of the ERU.

The soils with the lowest productivity and lowest amount of organic matter are located in the riparian forests (Cottonwood Willow Riparian Forest, Mixed Broadleaf Deciduous Riparian Forest, Montane Willow Riparian Forest) and the Desert Communities and Alpine Tundra ERUs. The soils in these riparian forests and ERUs cannot be expected to produce high amounts of understory and forage because they have low amounts of surface organic matter due to dry climate or having been recently formed.

Pinyon Juniper Woodland, Pinyon Juniper Evergreen Shrub, and Ponderosa Pine ERUs currently have low to moderate soil productivity (organic matter and understory and forage production) but have the potential, based on reference condition, to become more productive and produce higher amounts of understory in areas with low cover. As cover decreases through fire, insect and drought outbreaks, or vegetative treatments, herbaceous understory and forage production are anticipated to increase.

Biological Soil Crusts

An important component that affects soil condition is the condition of biological soil crusts. Biological soil crusts are the community of organisms, including cyanobacteria,[26] green algae, microfungi, mosses, liverworts, and lichens, living at the surface of soils (Belnap et al. 2001). Biological soil crusts are commonly found in, and play an important role in maintaining the productivity of Pinyon Juniper Woodland, Semi-desert Grassland, and Desert Communities ERUs on the forest. They are found to a limited extent in other vegetation types drier than Pinyon Juniper Woodland.

Crusts are well adapted to severe growing conditions, but poorly adapted to compressional disturbances. Domestic livestock and elk grazing, and more recently, recreational activities (hiking, biking, and off-road driving) can degrade the integrity of the crusts. Disturbance can decrease organism diversity, soil nutrients, soil stability, organic matter and soil productivity and increased soil loss. Biological crusts can be destroyed by surface fires.

Biological soil crusts on the Coconino NF are most prevalent in coarse-textured soils especially in Pinyon Juniper and Semi-desert Grassland ERUs. Most areas where crusts have been observed show damage to biological soil crusts from trampling or surface disturbance (Steinke, R., personal observations, 1989–2014).

[26] Cyanobacteria include a number of bacteria species that obtain their energy through photosynthesis.

Environmental Consequences

The environmental consequences related to soil condition and productivity discusses the proposed management direction in the alternatives that would generally apply across the forest and the anticipated forestwide environmental consequences to soil.

The primary difference relative to soil condition and productivity between all alternatives are the following management activities: number of recommended wilderness areas, wildland-urban interface and fire management in wilderness areas, number of management areas, number of water source for municipalities watersheds, additional management areas, limitations of public motorized vehicle access, limits on public road density, limits on large group recreation events, old growth, number of proposed research natural areas, the addition of a new geological and botanical area, mechanized use on designated system trails in geological and botanical areas, grazing in research natural areas, ROS, scenery management, snowmobiling and recreational shooting, inventoried roadless area direction, and semi-primitive nonmotorized recreation settings.

The magnitude and extent of soil disturbance associated within these areas, settings or activities would be very limited in extent and the magnitude of soil disturbance would be minor at the forest and ERU level. Consequently, implementation of these proposed activities is not expected to pose risk to soil condition or long-term soil productivity.

Each vegetation type was examined to see whether soil conditions would remain static or trend toward or away from desired conditions with the implementation of plan components including desired conditions, guidelines, and objectives of each alternative. The general effects to soil function from common management activities, such as forest restoration activities (mechanical and burning treatments), roads, recreation, grazing, and special uses under each alternative were considered in the evaluation of alternatives. Table 12 compares the projected trends in soil condition and productivity based on changes in vegetative ground cover, soil loss, and soil structure by alternative.

For alternative A, ERUs that have low levels of current departure from desired condition are expected to have trends of static to slowly toward desired condition since they are already close to their desired condition. The Desert Communities ERU has a moderate departure from desired condition with static trend, indicating alternative A will not appreciably improve this ERU. The ERUs that have high levels of departure from desired condition will move toward desired condition at different rates, depending on alternative. However, as can been seen in table 12, many ERUs that currently have high levels of departure from desired condition will either not move toward desired condition or will move toward desired condition at a slower rate than alternatives B (modified), C, and D.

Table 12. Estimated trends in soil condition/productivity for each ERU or riparian forest type by alternative

ERU or Riparian Forest Type	Current Departure from Desired Conditions[1]	Alternative A	Alternative B (modified)	Alternative C	Alternative D
Cottonwood Willow Riparian Forest	High	Slowly toward			
Mixed Broadleaf Deciduous Riparian Forest	Low	Static	Slowly toward		
Montane Willow Riparian Forest	Low	Static	Slowly toward		
Desert Communities	Moderate	Static	Slowly toward		
Semi-desert Grassland	High	Slowly toward	Slowly toward		
Great Basin Grassland	High	Slowly toward	Toward		
Montane/ Subalpine Grassland	Overall High (High for Montane, Low for Subalpine)	Static	Slowly toward		
Interior Chaparral	Low	Static	Toward		
Pinyon Juniper with Grass	Low	Away	Low objective: Slowly toward in short term the slowly away in long term High objective: Slowly toward in short term then static in long term		
Pinyon Juniper Evergreen Shrub	Moderate	Away	Slowly toward in treated areas, Static in other areas		
Pinyon Juniper Woodland (Persistent)	Moderate	Away	Slowly toward		
Ponderosa Pine	Low	Toward in treated areas, Static in other areas			
Mixed Conifer with Frequent Fire	Low	Static	Slowly toward		
Mixed Conifer with Infrequent Fire	Low	Static	Slowly toward		
Spruce-Fir	Low		Static		
Alpine Tundra	Low		Static		
Wetlands	High	Static	Slowly toward		

[1] Current departure estimates (USDA Forest Service 2009a, 2009c). Desired conditions are equivalent to reference conditions.

[2] Alternative A is based on the past 10-year average of treatments. Alternatives B (modified), C, and D are based on levels of treatment identified in plan objectives.

Forestwide

Common to All

Best Management Practices

Plan language under all alternatives directs implementing site-specific best management practices for ground-disturbing projects (1987 Plan, page 71, FW-Soil-G-1, 2, and 3). Best management practices would be identified by interdisciplinary teams to control or mitigate nonpoint source pollution for ground-disturbing activities. Identification of best management practices is guided by FSH 2509.22. (USDA Forest Service 1990) A guideline in alternatives B (modified), C, and D states that projects should be designed in a manner that avoids disturbance that could result in long-term impacts to soil

productivity (FW-Soil-G-2). This is a foundational best management practice for both planning and implementation of projects. Implementation of this guideline would avoid or limit ground-disturbing activities that could cause loss of protective vegetative ground cover, and detrimental soil disturbance including compaction or soils with high burn severity and sensitive soils with moderate or severe erosion hazard and calcareous soils that have high wind erodibility when exposed. Where such disturbances cannot be avoided, project-specific best management practices should be developed. Finally, specific project design features would be required on projects occurring on slopes greater than 40 percent grade where soils with moderate or severe erosion hazard ratings occur or where soils are sensitive to degradation when disturbed.

Filter strips and aquatic management zones

Alternative A includes direction for the protection of riparian areas through the use of filter strips (1987 Plan, pages 71 to 72). Alternatives B (modified), C, and D also include guidelines to use aquatic management zones for riparian areas (FW-Rip-All-G-3) and non-riparian intermittent streamcourses (FW-Rip-Strm-G-2) depending on site-specific conditions protecting water quality and the functioning of riparian forests. These guidelines recommend the width of the aquatic management zone based on the erosion hazard (severe, moderate, or slight) in the area. Guidelines for roads (FW-RdsFac-G-5) recommend that permanent and temporary road construction and relocation should occur outside of streamcourses and aquatic management zones, except where crossing is required; avoid wetlands, springs, seasonally wet meadows, and montane meadows; and avoid soils that are unstable and highly erodible where connected to streamcourses.

Whether projects use filter strips or aquatic management zones, the results should be similar; permanent damage to perennial plants would not occur, which would result in the maintenance of soil cover, reduced sheet erosion, and improved nutrient cycling and soil productivity. The aquatic management zones would be designed to reduce sedimentation, maintain channel function within floodplains, and maintain downstream water quality and riparian habitat and function. The aquatic management zones would also avoid detrimental changes in water temperature or chemical composition, blockages of streamcourses, and sediment deposits that could seriously and adversely affect water conditions, fish habitat, or connected downstream cave, karst, and lava tube resources.

Alternative A

Plan language that protects and enhances soil condition and productivity and reduces erosion and disturbance

Continuing implementation of Alternative A (current management) is in accordance with direction in the 1987 Forest Plan (as amended). Current plan direction to maintain or enhance soil productivity and put all areas forestwide in satisfactory condition by 2020 (1987 Plan, page 23) is unrealistic, vague or unattainable under current workforce, planning and implementation timelines and budget authority and would be difficult to achieve at the ERU scale.

Current plan rate of implementation for soil treatment including maintenance, protection and improvement (mechanical and fire included) over last 10 years ranges from about 5,400 to 27,000 acres (mechanical) and 15,000 acres per year (prescribed fire) in the Ponderosa Pine ERU and less in all others. These treatments do not target impaired soils and protection of satisfactory soil conditions but mainly focus on unsatisfactory soils. Generally, soil trends under alternative A range from static to toward desired condition.

Biological soil crusts

Alternative A does not recognize the importance of protecting soil crusts to maintain soil stability and productivity. Crusts are well adapted to severe growing conditions, but poorly adapted to compressional disturbances. Domestic livestock and elk grazing, and more recently, recreational

activities (hiking, biking, and off-road driving) place a heavy toll on the integrity of the crusts. Disruption of the crusts brings decreased organism diversity, soil nutrients, stability (and increased soil loss), and decreased organic matter and soil productivity. Studies of trampling disturbance have noted that losses of moss cover, lichen cover, and cyanobacterial presence can be severe, runoff can increase by half, and the rate of soil loss can increase six times without apparent damage to vegetation (Belnap et. al. 2001). Ungulate grazing in ERUs where crusts are present, poses an unquantifiable risk to soil productivity and ecosystem diversity and those species that depend on its habitat for their survival.

According to Belnap, et.al. (2001), biological crusts are generally killed by hot surface fires, resulting in loss of biomass and visible cover. Damage and recovery of biological crusts depends on pre-fire conditions as well as characteristics of the fire. Historic burning left small patches of unburned areas between bunchgrasses or at larger scales, left patches of unburned shrubs across the landscape. Historic fires in Pinyon Juniper and Semi-Desert Grassland ERUs were also relatively infrequent, which allowed for late successional stages of biological crusts to develop.

Coarse woody debris

Coarse woody debris is an important surface component of soils. It promotes resistance to accelerated erosion and improves nutrient cycling (USDA Forest Service 1994). Decomposing coarse woody debris can supply moisture to plants and animals after soils have dried. Coarse woody debris also provides important wildlife habitat components for soil micro and macro-fauna.

Alternative A would protect and maintain coarse woody debris through plan language that applies to all Mexican spotted owl and northern goshawk habitat (ponderosa pine and mixed conifer types), the entire Sedona/Oak Creek planning area, and all Pinyon Juniper types. Specific plan components are identified below. Current Plan guidance related to woody debris retention includes a guidelines for Mexican Spotted Owl Protected Activity Centers of retaining woody debris larger than 12 inches in diameter, snags, clumps of broad-leafed woody vegetation, and hardwood trees larger than 10 inches in diameter at the root collar when treating fuel accumulations to reduce risk of loss of these important habitat components (1987 Plan, page 65-2). There is also a standard for ecosystem management in northern goshawk habitats requiring management of uneven-age stand conditions for live trees and retaining live reserve trees, snags, downed logs, and woody debris levels throughout woodland, ponderosa pine, mixed conifer and spruce-fir forest cover types (1987 Plan, page 65-7). There is also a guideline for landscapes outside of goshawk post-fledging family areas that recommends an order of preference for managing woody debris. In order of preference, these are: (1) prescribed burning, (2) lopping and scattering, (3) hand piling or machine grapple piling, and (4) dozer piling (1987 Plan, page 65-9). Additionally, in goshawk post-fledging family areas located in the spruce-fir and mixed conifer forest types, the guideline recommends leaving at least 3 snags, 5 downed logs, and 10 to 15 tons of woody debris per acre (1987 Plan, page 65-9), while in the ponderosa pine forest type the guideline recommends leaving at least 2 snags per acre, 3 downed logs per acre, and 5 to 7 tons of woody debris per acre (1987 Plan, page 65-10). In the woodland forest type, the guideline recommends providing for reserve trees, snags, and down woody debris. The guideline for vegetation management within nesting areas recommends lopping and scattering of thinning debris where prescribed fire cannot be used and states that piling of debris should be limited (1987 Plan, page 65-11). The forestwide guideline for managing ground surface layers in all forest types recommends limiting piling of woody debris. This guideline further recommends hand or grapple piling when necessary to minimize soil compaction within piles and to minimize forest floor and herbaceous layer displacement and destruction and limiting dozer use for piling or scattering of logging debris, so that the forest floor and the herbaceous layer is not displaced or destroyed (1987 Plan, page 65-11).

Goals, objectives, standards and guidelines for the entire Sedona/Oak Creek Planning Area include an objective of increasing and improving the distribution of vegetative ground cover and coarse woody debris (1987 Plan, page 206-9). Objectives for the Sedona/Oak Creek Ecosystem include increasing and improving the distribution of vegetative ground cover and coarse woody debris (1987 Plan, page 206-10), and retaining dead and down woody materials, such as logs, limbs and flood debris, in riparian communities for prey base habitat (1987 Plan, page 206-11). The environmental consequences of increasing and improving the distribution of vegetative ground cover and coarse woody debris in the Sedona/Oak Creek Planning Area include improved soil stability and productivity, which decreases soil erosion and sediment transport to surface waters, including Oak Creek. Soil erosion and sediment transport have been identified as contributing factors to *E. coli* population levels in the Oak Creek Total Maximum Daily Load (TMDL).

Standards and guidelines for pinyon-juniper woodland (Management Areas 7 and 8) would also maintain or protect coarse woody debris by using lopping and scattering of slash after firewood harvesting to create a more moist microclimate; managing stands for at least two logs per acre of down woody material (9 inches in diameter or greater by 10 feet long; leaving lopped and scattered slash on 30 percent of area harvested) (1987 Plan, pages 151, 152, 153, 157). This would maintain ground cover, reduce the potential for accelerated erosion, promoted understory establishment and survival, improve regeneration potential, and provide cover for birds and small mammals.

Livestock grazing

Grazing decreases the amount of standing vegetative cover. It also reduces the amount of continuous plant litter and redistributes organic material by decreasing litter and increasing manure. The manure improves the nutrient status of soils and accelerates nutrient cycling within the ecosystem, but it is not distributed continuously across the landscape-like plant litter in ungrazed or lightly grazed areas. This situation may lead to an increase in the amount and size of patches of exposed soil which can lead to increased soil erosion rates. Grazing can reduce the amount of fine fuel, which can reduce natural fire frequency and intensity (i.e., lower flame length) in grasslands, allowing for establishment of trees and shrubs.

Grazing animals trample vegetation and damage soil surfaces by pulverizing soil aggregates. They can damage soil biological crusts through compressional disturbance. Although trampling may increase the speed at which organic matter (litter, manure, and woody debris) is incorporated into the soil and expose soil surfaces to improve seed germination and plant establishment, it can also increase soil compaction, decrease aggregate stability, and increase the risk of wind and water erosion, particularly in areas where livestock concentrate. Compaction reduces water infiltration rates, water-holding capacity, and soil aeration, which leads to losses in plant productivity. Compaction may increase runoff rates that contribute to sheet, rill and gully erosion.

Forestwide standards and guidelines in alternative A would mitigate potential impacts to soil condition and productivity from livestock grazing by requiring forage use by grazing ungulates to be maintained at or above a condition that assures recovery of Federally listed species; promoting the use of key forage monitoring areas to monitor average allowable use, and maintaining allowable use by utilizing site-specific forage use levels or employing an allowable use guide that incorporates range condition and management strategy (1987 Plan, page 66-1). Standards and guidelines would protect soil by maintaining a balance of permitted use and range capacity for range allotments by changing the numbers of livestock, changing management intensity levels, and initiating changes in livestock class, season of use, and rotation patterns. Various approaches of addressing permitted use and capacity are addressed in an environmental analysis of the Allotment Management Plans that at a minimum would consider range, riparian, and watershed conditions, economic feasibility,

implementation practicality, and wildlife habitat among other factors (1987 Plan, page 67). Various methods for controlling livestock distribution and preventing overuse which could damage soil are listed in the current plan. These methods include using cattleguards, waterlots, and salt; controlling livestock grazing through management and/or fencing to establish vegetation and eliminate overuse; and managing seeding projects to avoid concentrating livestock use in riparian and other sensitive areas (1987 Plan, pages 68 and 69). Other plan components emphasize rehabilitation of high-elevation riparian communities. Rehabilitation may include: wildlife and livestock grazing management, fencing, stream channel stabilization, road relocation, recreation management, and physical protection of revegetation work (1987 Plan, page 206-78). Additional plan components that would mitigate livestock impacts to soil are in specific management areas and are listed below. There is an objective for the entire Sedona/Oak Creek Planning Area include an objective for livestock grazing that maintains or improves soils condition and productivity (1987 Plan, page 206-10). Another objective requires that forest product removal, both personal and commercial, such as firewood gathering, Christmas tree cutting and livestock grazing, should be designed to maintain or restore ecosystem health and meet Sedona/Oak Creek Planning Area goals (1987 Plan, page 206-11). These objectives would ensure that soil disturbances from these activities do not exceed thresholds that cause soil condition or productivity to decline.

Guidelines for the Sedona/Oak Creek Planning Area recommend excluding livestock grazing in occupied southwestern willow flycatcher habitat to avoid direct impacts to flycatchers and their habitat (1987 Plan, page 206-13). However, this guideline does allow grazing in occupied southwestern willow flycatcher habitat outside of its critical season only where flycatcher research is occurring under a research plan approved by the Fish and Wildlife Service and other project cooperators. This guideline, therefore, provides only minimal protection of soils resources in riparian areas of the Sedona/Oak Creek Planning Area since it only protects areas where southwestern willow flycatcher occur and this protection is only provided to unoccupied habitat or occupied habitat outside of southwestern willow flycatcher critical season.

A guideline for commercial uses in the Savannah Management Area recommends livestock grazing and collection of minerals, firewood and native plants are consistent with other Sedona area-wide goals (1987 Plan, page 206-53).

Goals and objectives for mountain meadows in the Flagstaff/Lake Mary Ecosystem Analysis (FLEA) area recommend improvement to these areas to enhance soil productivity, biological diversity, and help maintain downstream water quality (1987 Plan, page 206-77 to 206-78). Improvement measures include: stream channel stabilization, improved cattle grazing strategy, and management of wildlife, recreation, and roads within these meadows.

Guidelines for the FLEA area recommend increasing and improving vegetative species composition and diversity in the surrounding landscapes to diffuse grazing pressure from elk and livestock (1987 Plan, page 206-78).

Guidelines for watersheds in the FLEA area recommend that roads, trails, camping, and grazing be managed to improve watershed condition particularly within mountain meadows, springs, and drainages (1987 Plan, page 206-100).

All of the goals, objectives and guidelines for the FLEA area would contribute to soils, vegetation and watershed condition by managing disturbances at levels that would prevent soil erosion and loss of soil productivity and associated adverse effects to water quality and watershed condition.

Minerals

Mineral extraction can have adverse effects on soils resources through complete removal and mixing or churning of soil horizons, increased bare ground subject to erosion by wind and water, soil compaction, changes to nutrient cycles, and soil contamination. Disruption of soil aggregates can result in changes to particle size distributions and reduced soil stability.

Management Direction for minerals requires the forest to support sound energy and minerals exploration and development and to administer the mineral laws and regulations to minimize adverse surface resource impacts (1987 Plan, page 24).

Forestwide Standards and Guidelines for leasable minerals prohibits surface occupancy where listed endangered species exist, on slopes greater than 40 percent, on areas where the VQO is foreground Retention, on the Montezuma Castle Backdrop Area, or the portion of Deadman Wash basin adjacent to Wupatki National Monument (1987 Plan, page 74). On a case-by-case basis, minor exceptions, such as a buried pipeline, may be considered provided the overall foreground Retention VQO is met. Soils resources in these areas would continue to be protected from adverse effects of extraction of leasable minerals.

Standards and Guidelines for Riparian and Open Water states that mineral material excavation within the riparian zone may be allowed after environmental analysis and authorized mineral activities will maintain or improve riparian conditions (1987 Plan, page 177). Activities such as gravel extraction, dredging, and washing in riparian areas and streamcourses could result in mixing or churning of soil horizons and channel substrates, increased bare ground subject to erosion by wind and water, soil compaction, and soil contamination. These activities also alter floodplains and channel morphology, increasing erosion and sedimentation rates. This standard and guideline would, therefore, be very difficult to achieve and would not likely protect soils in riparian areas.

Uncharacteristic Fire

Like the other alternatives, the current plan promotes reducing threats of uncharacteristic fire on departed vegetation types (1987 Plan, pages 65-2, 65-3, 65-4, 65-5, 65-11, 206-11, 206-75, 206-77). Reducing threats of uncharacteristic fires would reduce the risk of high soil burn severity that could otherwise result in accelerated soil erosion, loss of protective vegetative ground cover and tree and herbaceous species including riparian areas. However this language is not as strategic and does not have as much forestwide applicability as in alternatives B (modified,) C, and D. For example, the current plan supports the use of wildfire managed for resource objectives (1987 Plan, pages 65-4, 94, 111, 112, 137, 144, 147, 155, 157), however it is more difficult to implement than in alternatives B (modified), C, and D. Although language in the current plan promotes managing wildfires for resource objectives and protects long-term soil productivity, watershed function, water quality and riparian function, the plan language in the other alternatives has broader applicability and is easier to implement.

Alternative A does not allow wildfires managed for resource objectives in wildland-urban interface and has constraints on the use of this management tool in wilderness (1987 Plan, pages 111 to 112, 137, 140, 155, 157, 165, 170). This plan language would result in no acres treated in both the short term and long term in wildland-urban interface and wilderness, which would increase the potential for uncharacteristic fire in fire-adapted ERUs in wildland-urban interface and wilderness and negatively impact soil condition and productivity.

Increased acres of open states (0 to 30 percent canopy cover) (i.e., open stand structures) in Ponderosa Pine, Mixed Conifer with Frequent Fire, and Pinyon Juniper with Grass ERUs would indirectly benefit soil condition and soil productivity by reducing canopy closure and allowing more

precipitation and sunlight to reach the ground. This would have the effect of increasing understory production and ground cover, improving infiltration of water, increasing soil productivity, and reducing accelerated erosion. Reduced canopy closure and more open stands would also remove ladder fuels and break up contiguous tree canopies which contribute to larger areas burned and more vegetation and soil damaged by wildfires than what these ERUs historically experienced. More acres of open states would facilitate restoration of fire regimes to which these ERUS are adapted and reduce the risk of uncharacteristic fire.

Alternative A does not include express objectives to treat ERUs to have more open stand structures. However, it is assumed that treatments to achieve more open vegetative states (such as the 4 Forest Restoration Initiative) would occur under this alternative. Treatments on the Ponderosa Pine ERU would help move 203,279 to 300,533 acres to more open states over the next 15 years and 247,920 to 344,378 acres over the next 50 years. See table 13. For the Pinyon Juniper with Grass ERU, it is assumed that 113,732 acres would be in a more open state over the next 15 years, but the acres of open state drops to 84,972 over the next 50 years. This long-term decrease in open states occurs as regeneration and canopy closure outpaces treatment effects. This same trend would occur in Mixed Conifer with Frequent Fire ERU where it is assumed that 10,266 acres would be in a more open state over the next 15 years, but the acres of open state drops to 9,869 over the next 50 years.

Table 13. Acres of open states in Ponderosa Pine, Pinyon Juniper with Grass, and Mixed Conifer Frequent Fire ERUs

	All Alternatives Low Objective		All Alternatives High Objective		Alternative A		Alternatives B (modified), C, and D	
	15 years	**50 years**	**15 years**	**50 years**	**15 years**	**50 years**	**15 years**	**50 years**
Pinyon Juniper with Grass	-	-	-	-	113,732	84, 972	116,608	98,306
Mixed Conifer with Frequent Fire	-	-	-	-	10,266	9,869	14,779	16,465
Ponderosa Pine	203,279	247,920	300,533	344,378	-	-	-	-

Table 14. Plan objectives by alternative that would reduce fuel loading

Plan Code	Plan Objectives in Alternatives B (modified), C, and D	Alternative A
FW-TerrERU-Grass-O-1	Restore, or improve at least 3,500 acres of Semi-desert Grasslands during each 10-year period over the life of the plan.	No objectives Soils Report, page 41
FW-TerrERU-Grass-O-2	Restore or improve 10,800 to 12,400 acres of Great Basin Grasslands during each 10-year period over the life of the plan.	Similar to Alternatives B (modified), C, and D Soils Report, page 41
FW-TerrERU-Grass-O-3	Restore or improve 7,600 to 11,400 acres of Montane/Subalpine Grasslands during each 10-year period over the life of the plan.	Similar to Alternatives B (modified), C, and D Soils Report, page 41
FW-TerrERU-PJ-O-1	Mechanically treat between 1,000 and 10,000 acres of Pinyon Juniper with Grass during each 10-year period over the life of the plan.	Similar to Alternatives B (modified), C, and D Soils Report, page 42
FW-TerrERU-PJ-O-2	Use naturally ignited wildfires (i.e., lightning-caused fires that are managed for resource objectives) to treat at least 3,750 acres of Pinyon Juniper with Grass within the natural fire regime during each 10-year period over the life of the plan.	Similar to Alternatives B (modified), C, and D Soils Report, page 42
FW-TerrERU-AspMpl-O-1	Restore 1,000 acres of aspen and maple during each 10-year period over the life of the plan. Restoration could include, but is not limited to, activities that promote regeneration, remove competing vegetation, or remove disturbances that could negatively impact aspen or maple.	No objectives to improve maple or aspen. Soils Report, page 42
FW-TerrERU-PP-O-1	Use prescribed cutting to treat 50,000 to 260,500 acres of Ponderosa Pine during each 10-year period over the life of the plan.	Similar to Alternatives B (modified), C, and D Soils Report, page 42
FW-TerrERU-PP-O-2	Use prescribed fire to under burn 150,000 to 200,000 acres of Ponderosa Pine within the natural fire regime during each 10-year period over the life of the plan.	Similar to Alternatives B (modified), C, and D Soils Report, page 42
FW-TerrERU-PP-O-3	Use naturally ignited wildfires (i.e., lightning-caused fires that are managed for resource objectives) to treat 135,000 acres of Ponderosa Pine within the natural fire regime during each 10-year period over the life of the plan.	Similar to Alternatives B (modified), C, and D Soils Report, page 42
FW-TerrERU-MC-MCFF-O-1	Use prescribed cutting to treat 2,900 to 15,000 acres of Mixed Conifer with Frequent Fire during each 10-year period over the life of the plan.	Similar to Alternatives B (modified), C, and D Soils Report, page 42
FW-TerrERU-MC-MCFF-O-2	Use prescribed fire on at least 8,000 acres of Mixed Conifer with Frequent Fire within the natural fire regime during each 10-year period over the life of the plan.	Similar to Alternatives B (modified), C, and D Soils Report, page 42
FW-TerrERU-MC-MCFF-O-3	Use naturally ignited wildfires (i.e., lightning-caused fires managed for resource objectives) to treat at least 7,500 acres of Mixed Conifer with Frequent Fire within the natural fire regime, during each 10-year period over the life of the plan.	Similar to Alternatives B (modified), C, and D Soils Report, page 42

Roads

Roads convert productive soils to a non-productive condition for the life of the road. They therefore constitute an irretrievable, but not necessarily irreversible commitment of resources. Irretrievable is a term that applies to the loss of production, harvest, or use of natural resources. Irreversible is a term that describes the loss of future options. It applies primarily to the effects of use of nonrenewable resources, such as minerals or cultural resources, or to those factors, such as soil productivity, that are renewable only over long periods of time. Since soil productivity can typically be restored through application of remedial measures such as disking, scarification, revegetating, etc., loss of soil productivity is not necessarily irreversible. However, soil productivity is lost throughout the duration that a road exists on the landscape.

Most of the precipitation that falls on compacted road surfaces becomes runoff. This runoff can entrain soil particles, resulting in erosion and loss of future productivity.

Management direction under alternative A requires the forest to provide and manage a serviceable road transportation system that meets needs for public access, land management, resource protection, and user safety. Provisions are made for construction/reconstruction, maintenance, seasonal and special closures, and obliterating unnecessary roads (1987 Plan, page 24).

Forestwide standards and guidelines recommend locating new roads out of stream courses, water-collecting features such as swales, and wetlands. It further recommends that the forest relocate roads out of bottom positions and obliterate poorly located segments as they are identified. Adequate road drainage to be provided to prevent concentrated flow and sedimentation (1987 Plan, page 72). These standards and guidelines would protect soils resources from road-related erosion. However, relocating and decommissioning of roads under alternative A has not occurred at a sufficient pace to protect soils in many areas, resulting in roads that are chronic sources of sediment to drainages. Under alternative A, it is therefore likely that roads would remain a chronic source of sediment for the foreseeable future.

Forestwide standards and guidelines recommend that the forest enhance watershed condition by obliterating roads causing resource damage.

Forestwide standards and guidelines for road maintenance and management include recommendations for obliteration of roads not needed, maintaining access to the lowest standard necessary, and seasonal road closures for resource protection (1987 Plan, page 88). These practices would help to maintain soil productivity by preventing soil erosion and compaction associated with road use.

Water Supply Watersheds

The way water supply watersheds are managed can impact soil condition in those watersheds. The management direction on protection of water quality is also protective of soils resources.

Alternative A includes forestwide standards and guidelines for Municipal Watersheds. The current plan designates these as areas where communities obtain municipal water supplies by special authorization. Designated Municipal Watersheds include the Woody Well Field, San Francisco Peaks Inner Basin, and Lake Mary Well Field (1987 Plan, page 85). Standards and guidelines recommend that the forest (a) cooperate with municipalities and water companies to achieve an ownership pattern necessary to protect and improve the watershed and (b) acquire non-public lands within a watershed to improve or correct management activities incompatible with maintenance of watershed condition and water quality (1987 Plan, page 85).

Management Direction for the Inner Basin (Management Area 16) emphasizes protection of watershed condition because of the area's importance for water collection for the City of Flagstaff and visual quality (1987 Plan, page 191). The area is open to day-use foot traffic, but closed to domestic livestock and public travel by vehicle (1987 Plan, page 192). Protecting water quality is the primary management direction.

Area-wide goals and objectives for the FLEA area recognize the importance of Upper and Lower Lake Mary as municipal water sources for the City of Flagstaff (1987 Plan, page 206-77). The Lake Mary watershed is a high priority for watershed restoration and maintenance for ecological and socio-economic reasons (1987 Plan, page 206-77). Guidelines require implementation of best management practices commensurate with municipal values and the plan (1987 Plan, page 206-77). If goals and objectives for mountain meadows in the Flagstaff/Lake Mary Ecosystem Analysis (FLEA) area are achieved, soil productivity and ecological function would be improved, vegetative biological diversity would increase, and stream channel morphology would be improved.

ROS/Suitability

Recreation Opportunity Spectrum (ROS) and Wilderness Recreation Opportunity Spectrum (WOS) classifications affect how forest land is managed, which in turn can impact soil condition. The more restrictive ROS classifications (ROS - Semi-primitive and Primitive; WROS – Transition, Semi-primitive, Primitive, and Pristine) can limit or reduce human-induced ground disturbance, which can be beneficial for soil condition. These benefits to soil condition can include reduced road miles and associated areas of bare ground and compacted soils, and undisturbed native plan communities.

Alternative A includes a goal of continuing to integrate the ROS system into the forest planning process to quantify recreation opportunities changes, guide management, and coordinate recreation with other resources (1987 Plan, page 22). Additionally, goals for recreation in wilderness (Management Area 1) express that Pristine and Primitive WOS/ROS settings predominate (1987 Plan, page 108-1).

Under alternative A, there would be 158,606 acres characterized as Primitive, 117,947 acres characterized as Semi-Primitive Non-Motorized, 715,448 acres characterized as Semi-Primitive Motorized, 820,089 acres characterized as Roaded Natural, and 29,543 characterized as Rural. There would be no acres classified under the WROS.

Except for the developed areas of Childs and Beasley Flat, the Verde Wild and Scenic River is managed for a predominantly uncrowded setting. The character of recreation settings is identified and managed through the Recreation Opportunity Spectrum (ROS). Recreation use activities and capacities are established for commercial and non-commercial uses consistent with outstandingly remarkable values and ROS/WOS (Wilderness Opportunity Spectrum) classifications (1987 Plan, page 115-4).

Management of the Mount Elden/Dry Lake Hills area is guided by semi-primitive nonmotorized ROS class (1987 Plan, page 119).

Objectives for the Casner RNA requires managing recreation for Semi-primitive Non-Motorized ROS setting (1987 Plan, page 196-1).

Recreation Objectives for the Sedona/Oak Creek Area require increasing opportunities for Semi-primitive and Primitive ROS experiences to better meet the high demand for this type of recreation setting (1987 Plan, page 206-22).

These plan components would provide for maintenance and protection of soil condition and productivity in Wilderness (MA 1) since they would limit human-caused soil disturbances. Soils in areas characterized as Semi-Primitive Non-Motorized would remain static unless future site-specific NEPA decisions to reduce motorized use in order to limit human-caused soil disturbances.

Lead Contamination/Soil Quality

Recreational shooting has the potential to impact soil quality because lead ammunition can be a source of contamination and lead is a known environmental contaminant, especially for children. Lead concentrations associated with shooting ranges can be a significant source of lead contamination in soils (Hardison et al. 2003). Lead in soil can be toxic to micro-organisms (bacteria and fungi) and invertebrates. High lead concentrations (500 to 1,000 ppm) in soil can alter or destroy soil micro-organism and invertebrate populations, reducing rates of organic matter decomposition. Some soil micro-organisms are more lead-tolerant than others, so shifts in soil microbiological populations can occur. Changing or destroying micro-organism populations would affect soil formation processes, resulting in soil conditions that are outside the natural range of variation for a particular soil.

Lead can move from the soil in a number of ways. Predators consuming large numbers of invertebrates with high lead concentrations can accumulate lead to toxic levels, so lead can bioconcentrate in terrestrial and aquatic environments, but it does not biomagnify. Lead can be uptaken from soil by many plants where it can be stored in roots and foliage. In some plants, lead can accumulate to toxic levels, resulting in stunted growth, decay and death. Foraging animals can be affected by lead when consumed in plant materials. Once ingested, lead can affect the central nervous system of animals and inhibit their ability to synthesize red blood cells.

Recreational shooting on the forest is expected to be a dispersed activity, not concentrated as in a shooting range. Therefore, recreational shooting on the forest is not assumed to result in levels of lead contamination that impact desired conditions on the forest. Furthermore, recreational shooting is not assumed to be ground-disturbing. There is no known monitoring on the forest for lead contamination.

There are about 216,000 acres on the forest where recreational shooting is currently not allowed due to existing policy or laws (near structures, roads, and water) under all alternatives. Due to these existing shooting restrictions, risk of soil contamination by lead is very low and would result primarily from atmospheric sources and not lead ammunition in these areas.

There no plan components under alternative A that would prevent lead contamination of soils as a result of concentrated shooting.

Wilderness/RWA

Management associated with special areas, such as designated wilderness areas, recommended wilderness areas, research natural areas, and geological and botanical areas, can be designed to restrict impacts associated with development and recreation. This management can be beneficial for soil condition through reduced adverse effects to soils such as trampling, compaction, loss of vegetative cover and litter and associated accelerated erosion. Motorized and mechanized use is not allowed in designated wilderness. Motorized use is allowed to a limited extent in recommended wilderness. This more restrictive management can result in reduced treatments in these areas, because motorized or mechanized use is often needed to control fires, to thin areas prior to burning, and to provide for firefighter safety. Increased fuel loads that can result in a corresponding increase in risk of high-severity wildfire, which can have detrimental impacts to soil condition and productivity.

Alternative B (modified)

Plan language that protects, enhances soil condition and productivity and reduces erosion and disturbance

Implementing plan direction in alternative B (modified) has potential to improve soil condition and productivity and move most ERUs toward desired condition based on predicted implementation of plan components, including objectives. Table 12 provides the estimated trends in soil condition/productivity for each ERU and riparian forest type by alternative.

The forestwide objective for soils (FW-Soil-O-1) is to maintain satisfactory soil conditions and/or improve impaired and unsatisfactory soil conditions on 100,000 to 350,000 acres during each 10-year period over the life of the plan. Alternative B (modified) therefore provides additional and more site-specific direction that favors maintenance and improvement of soil condition and productivity including all conditions of soils (i.e., satisfactory, impaired and unsatisfactory) than alternative A. Maintenance and improvement would occur as a result of some management actions in other resources. For example, such actions as relocating a roads in grasslands, improved grazing strategies, road decommissioning and removal of OHV traffic from erodible soils could improve impaired soil conditions.

Forestwide guidelines for roads and facilities (FW-RdsFac-G-1 through 10) incorporate best management practices and design features that prevent soil erosion and adverse effects to water quality during road construction and maintenance activities. One of those guidelines (FW-RdsFac-G-5) specifically recommends that permanent and temporary road construction and relocation should occur outside of streamcourses and aquatic management zones, except where crossing is required; avoid wetlands, springs, seasonally wet meadows, and montane meadows; and avoid soils that are unstable and highly erodible where connected to streamcourses. Recommended widths for aquatic management zones have been included in riparian area guidelines (FW-Rip-All-G-3 and FW-Rip-Strm-G-2).

Under alternative B (modified) proposed objectives, between 5 and 20 percent of all soils would be treated (maintenance, protection or improvement) and up to about 70 percent of impaired and unsatisfactory soils could be treated targeting soils and ERUs that have the greatest need for improvement.

The overall objective in alternative B (modified) of maintaining or improving soil conditions on 100,000 to 350,000 acres during life of plan (FW-Soil-O-1) is realistic where plan language for alternative A is unrealistic and has not been achieved. In addition, many ERUs have treatment objectives under alternative B (modified) (in Ponderosa Pine, Pinyon Juniper, Mixed Conifer Frequent Fire, Semi-desert Grassland, Great Basin Grassland, Montane Grassland, and Aspen, including use of naturally ignited fire (FW-TerrERU-Grass-O-1, 2, and 3, FW-TerrERU-AspMpl-O-1, FW-TerrERU-MC-MCFF-O-1, 2, and 3; FW-TerrERU-PJ-O-1, 2, and 3, FW-ERU-PP-O-1, 2, and 3). The soils in those ERUs would move toward identified desired conditions better than alternative A because the objectives would place more emphasis on improving those ERUs and soil conditions. However, in treated areas, alternative A would be expected to have about the same level of mechanical and fire treatment as in alternative B (modified) in the Ponderosa Pine, Pinyon Juniper with Grass, and Mixed Conifer ERUs. In treated areas in those ERUs, movement toward identified soil desired conditions would be at about the same rate as alternative B (modified). Outside of treated areas, implementation of alternative A would result in static trend with regard to desired condition in Ponderosa Pine and Mixed Conifer Frequent Fire and away from desired condition in Pinyon Juniper with Grass ERUs.

Biological soil crusts

Alternative B (modified) includes direction to protect soil biological crusts (FW-Soil-DC-4). This desired condition states that biological soil crusts stabilize soil and improve nutrient cycling. Alternative A does not recognize the importance of protecting soil crusts to maintain soil productivity. Implementing plan direction for alternative B (modified) would better protect biological soils crusts and improve soil nutrient cycling where biological soil crusts occur compared to alternative A.

Alternative B (modified) would allow concentration of treatments in focus watersheds or particular ERUs needing soil improvement (FW-Water-G-2), such as the Semi-desert Grassland ERU. This targeted approach would allow better opportunity for restoring or maintaining watersheds and soil condition in specific ERUs that are most departed from reference conditions.

Coarse woody debris

Alternative B (modified) includes plan components that would direct management and treatments that would very slowly move soils toward identified desired conditions (FW-Soil-DC-1 through 5) where activities would protect soil function including maintenance of coarse woody debris and not result in accelerated erosion above threshold levels and subsequent loss of overall soil productivity. However, coarse woody debris is not present in the Semi-desert Grassland ERU, and therefore, has no bearing on soil function.

Alternative B (modified) includes desired conditions for all terrestrial ERUs (FW-TerrERU-All-DC-1 through 5). One of these desired conditions states that natural and human disturbances provide desired overall plant density, species composition (mix of species), structure, coarse woody debris, and nutrient cycling (FW-TerrERU-All-DC-2). Desired disturbance regimes, including fire, are restored where practical (FW-TerrERU-All-DC-2).

The forestwide desired conditions for pinyon juniper ERUs address coarse woody debris. The Pinyon Juniper with Grass ERU has a desired condition for coarse woody debris to increase with succession and average 1 to 3 tons per acre (FW-TerrERU-PJ-DC-2). The Pinyon Juniper with Grass and Pinyon Juniper Evergreen Shrub ERUs have a desired condition that provides for old growth components including old trees, dead trees (snags), downed wood (coarse woody debris), and structural diversity (FW-TerrERU-PJ-DC-5). A forest wide Pinyon Juniper Evergreen Shrub desired condition, recommends snags and old trees with dead limbs/tops to be scattered across the landscape (FW-TerrERU-PJ-DC-7). Furthermore, this desired conditions envisions large dead wood, snags, and coarse woody debris to be present in this ERU. Snags 8 inches and above at diameter at root collar should average 3 snags per acre, while snags 18 inches and above average 1 snag per acre. Coarse woody debris averages 2 to 4 tons per acre.

A guideline for Pinyon Juniper ERUs would require retention of slash piles across the landscape to increase small mammal occupancy in areas where coarse woody debris is deficient and to provide nesting habitat and cover for turkeys, birds, small mammals, reptiles, and invertebrates. The number and distribution of retained slash piles should be consistent with scenic integrity objectives (SIO) and balanced with potential threats from bark beetles and fire/fuels concerns. If slash is scattered, it should be at a height that still allows big game movement (FW-TerrERU-PJ-G-4).

Livestock grazing

A desired condition for livestock grazing promotes permitted livestock grazing to be consistent with the desired conditions of other resources, which would include maintenance of soil condition and productivity (FW-Graz-DC-2). However, this desired condition does recognize that conditions immediately adjacent to livestock concentration areas, such as earthen stock ponds, developed

springs, and other features that concentrate livestock, may be inconsistent with general desired conditions for vegetation and soils such as lower levels of vegetation and higher levels of soil compaction.

Several guidelines associated with livestock grazing would be beneficial for soil quality. One guideline for livestock grazing requires livestock grazing to be managed to meet, or move toward, the desired conditions for forest resources such as soil, water, vegetation, and species (FW-Graz-G-2). Another guideline requires sufficient rest of burned or mechanically treated areas from livestock grazing, especially during the growing season, to ensure plant recovery and vigor and to ensure that perennial plants would not be permanently damaged by grazing (FW-Graz-G-3). Grazing is not to be authorized in burned or mechanically treated areas until Forest Service specialists determine plant recovery and vigor in the burned or treated area is sufficient by considering characteristics such as seed heads or flowers, multiple leaves or branches, and/or root systems that do not allow them to be easily pulled from the ground. These characteristics provide evidence of plant recovery, vigor, and reproductive ability.

Minerals

Alternative B (modified) as several plan components related to mineral resources that would be beneficial to soil quality. A desired condition for mineral resources requires that mineral and mining activities meet the legal mandates to facilitate the development of minerals on the Coconino NF in a manner that minimizes adverse impacts to surface and groundwater resources, and that do not detract from maintaining or meeting other desired conditions applicable to the area (FW-Minerals-DC-1). A mineral resources standard would be protective of soils resources where archaeological sites or places of cultural importance to American Indian tribes that have been determined to be eligible or may be eligible for the National Register of Historic Places occur (FW-Minerals-S-1).

Guidelines to withdraw areas from locatable mineral entry and to apply restrictive stipulations for leasable minerals under FW-Minerals-G-3 would protect soils from adverse effects of mining activities (FW-Minerals-G-1 and 3). In addition, soils would be protected or maintained where they occur in important wildlife and plant habitats, visually sensitive areas, archaeological sites, places of cultural importance to American Indians, and areas with large capital investments that could be protected through surface occupancy restrictions, mitigation measures, and operating plan requirements imposed on mineral activities (FW-Minerals-G-4).

Finally, a guideline directs past and present mining operations to be reclaimed to minimize impacts to natural resources (FW-Minerals-G-5). Through reclamation of past and present mining operations, soil resources would be improved. While the condition and productivity of soils that occur in past and present mining areas could be improved, it is very unlikely that they could ever return to reference conditions.

Uncharacteristic Fire

Alternative B (modified) makes managing wildfires for resource objectives more probable by having clear objectives that are consistent with fire treatment (FW-TerrERU-PP-O-3, FW-TerrERU-PJ-O-2 and 3). Alternative B (modified) also includes guidelines that emphasize fire treatment in the wildland-urban interface and encourage the use of fire to move ERUs toward desired conditions (FW-Fire-G-1 and 2). In addition, there are forestwide management approaches that emphasize fire treatment planning and implementation (FW-Fire-Management Approaches).

Although all alternatives recognize the importance of prescribed fire in the wildland-urban interface, alternative B (modified) explicitly allows wildfires to be managed for resource objectives in the wildland-urban interface and Oak Creek Canyon. Alternative B (modified) also more clearly

articulates the need to manage for the most resilient and least volatile forest composition and structure in the wildland-urban interface (FW-WUI-DC-2 through 9). This more resilient condition would take the form of more open stands with lower tree densities and fuel loads (including logs and snags). Similarly, a guideline in alternative B (modified) supports fire treatment to achieve desired conditions in wilderness areas (FW-Fire-G-2).

Outside of wildland-urban interface, Wilderness areas and Special Areas, the primary difference in potential fire treatment between the alternatives is in desired conditions. Alternative B (modified) has desired conditions that highlight the need for fire to achieve and/or maintain composition, structure and function of fire-adapted ERUs(FW-TerrERU-PP-DC-2 and 3, FW-TerrERU-MC-MCFF-DC-4 and 8, FW-TerrERU-PJ-DC-4).

The desired conditions for the Inner Basin, Lake Mary, and C.C. Cragin management areas direct that risk of substantial damage from high-severity fire to water supply, infrastructure, water quality, visual quality, and cultural integrity (tribes and local communities) is low (MA-InBsn-DC-4, MA-LkMary-DC-1, MA-CCCrg-DC-1). By maintaining a low risk of damage to these resources from uncharacteristic fire, damage to soils resources would also be low.

Unlike alternative A, alternative B (modified) includes express objectives to treat ERUs, which would result in more open stand structures and reduced fuel loading (FW-TerrERU-Grass-O-1, 2, and 3, FW-TerrERU-PJ-O-1 and 2, FW-TerrERU-AspMpl-O-1, FW-TerrERU-PP-O-1, 2, and 3, FW-TerrERU-MC-MCFF-O-1, 2, and 3). Like alternative A, treatments on the Ponderosa Pine ERU would help move 203,279 to 300,533 acres to more open states over the next 15 years and 247,920 to 344,378 acres over the next 50 years. See table 13. For the Pinyon Juniper with Grass ERU, alternative B (modified) would result in slightly more acres in a more open state over the next 15 years than alternative A (116,608 compared to 113,732), with a greater increase over the next 50 years (98,306 compared to 84, 972). Similar differences are noted for the Mixed Conifer with Frequent Fire ERU which would result in slightly more acres in a more open state over the next 15 years than alternative A (14,779 compared to 10,266), with a greater increase over the next 50 years (16,465 compared to 9,869).

Roads

Desired conditions for Roads and Facilities provide opportunities to improve soil condition and productivity. Alternative B (modified) includes a forestwide desired condition that would lead to improved soil condition and productivity through well maintained roads that protect watershed conditions, recreation opportunities, scenery, heritage resources, rare plants, fisheries, and wildlife habitat and movement (FW-RdsFac-DC-1). Another forestwide desired condition would improve soil productivity since temporary roads used to support ecosystem restoration activities, fuels management, or other short-term projects would be rehabilitated promptly after project completion (FW-RdsFac-DC-3). Another forestwide desired condition requires a minimum road system necessary for public, administrative, and private access within areas that affect water supplies, such as the Inner Basin, C.C. Cragin Reservoir, and Upper and Lower Lake Mary, protects water quality and quantity (FW-RdsFac-DC-4), thereby minimizing soil erosion from road surfaces.

The forestwide objective for roads and facilities (FW-RdsFac-O-1) would improve soil condition and productivity through decommissioning of 200 to 800 miles of unauthorized roads and system roads not identified on the motor vehicle use map during the 10 years following plan approval.

Guidelines for roads and facilities would also contribute to improved soil condition and productivity. Specific guidelines for roads that contribute to improved condition include: roads that are located, designed, and maintained to move toward or maintain desired conditions for other uses and resources

(FW-RdsFac-G-1), roads that have adequate drainage to avoid accelerated soil erosion, loss of vegetation, and long-term impacts to soil productivity (FW-RdsFac-G-2), and roads that are signed to facilitate navigation of designated motorized routes and to prevent motorized use outside of designated areas and routes (FW-RdsFac-G-3). Another forestwide guideline requires implementation of BMPs to prevent soil erosion and adverse effects to water quality; avoiding wetlands, springs, seasonally wet meadows, and montane meadows; and avoiding soils that are unstable and highly erodible where connected to streamcourses (FW-RdsFac-G-5). Unneeded roads would be decommissioned to maintain an efficient and sustainable road system that maintains or moves toward other resource desired conditions (FW-RdsFac-G-6). Existing roads would be used or realigned before new roads are constructed (FW-RdsFac-G-7), which would minimize soil disturbance and adverse effects to soil productivity. Projects not requiring long term access could be served by installation of lower impacts temporary roads that would be naturalized in a timely manner following project implementation (FW-RdsFac-G-8).

A management approach provides a framework to assist forest managers in prioritizing the naturalization of decommissioned and unauthorized roads for the following reasons: a) risk of damage to soils that would reduce long term productivity, b) presence of riparian areas that are impaired due to sedimentation or altered hydrology, and c) montane meadows that would be at risk of damage. The following criteria could be used to guide prioritization: a) soils that are receiving, or are expected to receive, damage to the extent that soil productivity is or will be significantly impaired outside of the road prism, b) riparian areas (springs, wetlands, or stream reaches) that are impaired or non-attaining due to sedimentation or altered hydrology resulting from the road presence, c) meadows at the TEUI montane meadows polygon map unit scale that are likely to be or are being damaged, and d) poorly located, designed, or maintained roads connected to downstream impaired or non-attaining waters, where potential for increased runoff and sedimentation is high.

Water Supply Watersheds

Alternative B (modified) has three management areas that include portions of watersheds that supply water to the City of Flagstaff, or Town of Payson, and other Gila County communities: Lake Mary Watersheds, Inner Basin, and C.C. Cragin. Associated plan language would further protect soil condition and productivity by emphasizing a low risk of substantial damage from uncharacteristic fire and flooding to water quality and quantity (from sedimentation) in these areas (MA-LkMary-DC-1 and G-1; MA-CCCrg-DC-1and G-1; MA-InBsn-DC-4). In addition, guidelines would prevent or reduce erosion and sedimentation through maintenance of roads and trails (MA-LkMary-G-2, MA-CCCrg-G-2). Desired conditions in the Inner Basin MA further support properly functioning watersheds and soils and a sustainable mix of recreational opportunities in balance with function watershed, soil, and vegetative conditions (MA-InBsn-DC-1, 2, 4 and G-2). Guidelines would also improve soil condition by maintaining roads and trails, restricting motorized access in certain areas, and limiting dispersed recreation to day-use traffic, by foot or bicycle (MA-InBsn-G-4, 5, and 7). Furthermore, there is a forest plan standard that would not permit recreational livestock use such as horses, pack stock, mules, or llamas in the Inner Basin MA above the watershed cabin (MA-InBsn-S-1). Finally, the Inner Basin is classified as unsuitable for livestock grazing, which means livestock grazing is not compatible with desired conditions for the area. These plan components should protect soils and watershed resources from uncharacteristic fire that results in high burn severity, accelerated erosion, and loss of soil productivity.

Although alternative A has management direction for the Woody Well Field, San Francisco Peaks Inner Basin, and Lake Mary Well Field, it does not include the more specific and comprehensive direction included in alternative B (modified). The expanded direction in alternative B (modified) is

expected to provide better protection and faster improvement of soil condition and productivity than alternative A.

ROS/Suitability

The ROS classifications under alternative B (modified) would provide more Semi-primitive Non-motorized (206,592 acres compared to 117,974 acres) and less primitive (14,098 acres compared to 158,606 acres) than alternative A. Alternative B (modified) would classify all of the designated wilderness acres managed by the Coconino NF) under the Wilderness Opportunity Spectrum (Transition = 19,299 acres, Semi-primitive = 37,205 acres, Primitive = 52,621 acres, Pristine = 42,205 acres, total acres = 151,330). The higher amount of acres in these ROS and WOS categories under alternative B (modified) (372,020 acres compared to 276,580 acres) should result in reduced disturbance to soils and improved soil condition on an additional 95,440 acres under this alternative.

Alternative B (modified) includes suitability determinations for a variety of recreation and transportation related uses. The primary uses that could affect soil and water quality are permanent roads, temporary roads, and motorized trails because of the actual amount of exposed soil susceptible to erosion and sediment delivery into streamcourses. This alternative includes suitability determinations for new motorized areas, which would guide where areas for cross country motorized travel would be authorized. These suitability determinations would restrict ground-disturbing activities, which should protect long term soil productivity better than alternative A, which does not include recreation and transportation suitability determinations.

Lead Contamination/Soil Quality

Alternative B (modified) has several plan components that address the potential impacts of lead contamination to soil and water quality. Alternative B (modified) includes desired conditions for soils to function properly (FW-Soil-DC-1 and 2) and for water quality to support ecological functions and meet or exceed Arizona water quality standards (FW-Water-DC-6 and 7). Alternative B (modified) has management approaches for all recreation that include collaboration with the Arizona Game and Fish Department, local law enforcement, and other stakeholders to address issues and opportunities related to recreational shooting on the Coconino NF. Plan direction under alternative B (modified), therefore, provides more protection for soils resources from lead contamination than alternative A .

Wilderness/RWA

Alternative B (modified) provides direction for designated wilderness areas, recommended wilderness areas, designated and eligible wild and scenic rivers, national trails, scenic roads, established and proposed research natural areas and designated botanical and geological areas, and inventoried roadless areas.

Where the plan provides plan decisions (desired conditions, objectives, standards, guidelines, suitability determinations, or monitoring) specific to a special area, a project or activity must be consistent with those area-specific decisions. The project documentation should describe how the project or activity is consistent with the area specific decisions of the plan.

Alternative B (modified) would recommend three wilderness areas: Abineau, Davey’s, and Strawberry Crater. The few roads and motorized trails that occur in these recommended areas have little impact on soil condition and productivity and plan language would support maintenance and/or improvement of soil condition and productivity. Desired conditions for recommended wilderness would maintain or enhance undeveloped characteristics; reduce evidence of modern human control; result in little evidence of structure, construction and other signs of modern human presence; and promote levels of mechanized recreation that maintain and do not detract from wilderness values

(SA-RWild-DC-1, 2, 5, and 6). Plan guidelines would also not expand the evidence of motor vehicle and mechanized equipment use beyond current conditions; would promote motor vehicle use only for limited administrative and permitted activities; and would design new trail for non-motorized and non-mechanized activities to preserve the area's wilderness character (SA-RWild-1, 3, and 5). There would be no change in grazing associated with the recommended wilderness areas and therefore no differences in any impacts to soil condition and productivity between alternatives.

Alternative C

Except as discussed below, there are no appreciable or measurable differences in plan components for soil between alternative C and alternative B (modified). As a result, alternative C would move soil condition toward desired conditions at about the same rate as alternative B (modified) unless otherwise indicated below.

Plan language that protects, enhances soil condition and productivity and reduces erosion and disturbance

Implementing plan direction in Alternative C has potential to improve soil condition and productivity and move most ERUs toward desired condition based on predicted implementation of plan components, including objectives. There are no appreciable or measurable differences in plan objectives for protecting or enhancing soil condition and productivity and reducing erosion and disturbance between alternative C and alternative B (modified). Table 12 provides the estimated trends in soil condition/productivity for each ERU and riparian forest type by alternative.

Livestock grazing

Alternative C is similar to B (modified), except grazing would be excluded from research natural areas unless grazing supports or would not affect the area's research purpose. There is little to no grazing in research natural areas on the forest. This language would result in little to no impacts to soil, therefore, there are no appreciable or measurable differences in plan direction compared to alternative B (modified).

Roads

Alternative C could close (administrative use allowed) or decommission roads in seven management areas emphasizing reduced disturbances to wildlife habitat, while other alternatives do not. Since road corridors would still be present while allowing administrative use, soil condition or productivity would not be appreciably improved. However, where roads are decommissioned, or obliterated, or no traffic is allowed, soil stability and productivity in affected MAs (Second Chance and Limestone) could improve slightly since soil compaction and erosion risk would be reduced. Similarly, decommissioning roads in Pine Grove MA could improve soil stability and reduce soil erosion. Decommissioning roads in the Anderson Mesa MA would also improve soil stability and reduce erosion in this MA.

Alternative C would have fewer suitable acres for temporary and permanent roads and motorized areas which could protect soil productivity slightly better than alternatives B (modified) and D in localized areas including the Upper Clear Creek 5th level HUC watershed. However, at the ERU or forest scale, it is not expected to be appreciably different in magnitude of effects in reducing adverse effects to soil productivity. Therefore, predicted soil improvement would be similar to alternatives B (modified) and D at the ERU and forest scale.

In new MAs, there would be no net increase in the area of motorized dispersed camping corridors and roads providing public access could be limited. Roads would be limited to administrative use or decommissioned. However, road corridors would still be present unless fully obliterated, limiting the

effectiveness of alternative C in improving overall soil productivity in those MAs any better than alternatives B (modified) or D.

Water Supply Watersheds

Unlike alternative B (modified), alternative C does not have the three management areas that include portions of watersheds that supply water to the City of Flagstaff, or Town of Payson, and other Gila County communities: Inner Basin, Lake Mary Watersheds and C.C. Cragin Watersheds. Consequently, alternative C does not have the plan components that provides additional protection to these areas. While, forestwide language common to alternatives B (modified) and C would protect soil condition and productivity equally, the more specific and comprehensive direction included in alternative B (modified) for the three watershed management areas is expected to provide better protection and faster improvement of soil condition and productivity than alternatives C and A.

ROS/Suitability

The ROS classifications under alternative C would provide less Semi-primitive Non-motorized (150,426 acres compared to 206,592 acres) and more Primitive (96,249 acres compared to 14,098 acres) than alternative B (modified). Alternative C would provide more Semi-primitive Non-motorized (150,426 acres compared to 117,974 acres) and more Primitive (96,249 acres compared 158,606 acres) than alternative A. Like alternative B (modified), alternative C would classify all of the designated wilderness acres managed by the Coconino NF) under the Wilderness Opportunity Spectrum (Transition = 19,299 acres, Semi-primitive = 37,205 acres, Primitive = 52,621 acres, Pristine = 42,205 acres, total acres = 151,330). Alternative C has more acres classified in these ROS and WOS categories (398,005 acres compared to 372,020 and 276,580 acres) that alternatives B (modified) and A, respectively, which should result in reduced disturbance to soils and improved soil condition on an additional 25,985 acres compared to alternative B (modified) and an addition 121,440 acres compared to alternative A. The effects related to the ROS classifications under are expected to be similar to alternative B (modified).

Like alternative B (modified), alternative C includes suitability determinations for a variety of recreation and transportation related uses. Overall, the magnitude of difference amongst alternatives is low but Alternative C would probably slightly better protect soil productivity compared to alternative B (modified), but only at the localized scale including Upper Clear Creek 5th HUC watershed.

Lead Contamination/Soil Quality

In addition to the plan components related to lead contamination under alternative B (modified), alternative C would have areas classified as not suitable for recreational shooting (does not include hunting). These areas are proposed and designated research natural areas, botanical and geological areas, and the following management areas: Anderson Mesa, Blue Ridge, Hospital Ridge, Limestone Pasture, Second Chance, Knoll Lake, Pine Grove, Jack’s Canyon, Walnut Canyon, Sedona Neighborwoods, and Long Valley. Portions of the Flagstaff Neighborwoods may not be suitable for recreational shooting; however, this determination should be made through project-level NEPA analysis.

There are about 216,000 acres on the forest where recreational shooting is currently not allowed due to existing policy or laws (near structures, roads, and water) under all alternatives. Alternative C would classify about 492,600 acres as not suitable for recreational shooting. This would result in 1,134,333 acres classified as suitable for recreational shooting, about 492,600 classified as not suitable for recreational shooting, and about 216,000 acres on which recreational shooting is currently not allowed. This is the only alternative with suitability for recreational shooting. Plan

direction under alternative C, therefore, provides more protection for soils resources from lead contamination than alternatives A or B (modified).

Wilderness/RWA

Alternative C recommends 13 new wilderness areas, includes eight management areas with most focusing on reduced motorized vehicle disturbance, reduces the amount of designated roads (allow for administrative use or decommission), restricts the size of new camping corridors (Anderson Mesa, Blue Ridge, Knoll Lake, Hospital Ridge, Limestone, Second Chance and Pine Grove MAs), designates some areas as not suitable for recreational shooting and designates some management areas as semi-primitive non-motorized. However, these areas already exhibit very little soil disturbance caused from human activities. Consequently, the additional direction under alternative C is not expected to appreciably improve soil condition in these areas more than alternative B (modified).

Alternative D

Except as discussed below, there are no appreciable or measurable differences in plan components for between alternative D and alternative B (modified). As a result, alternative D would move soil condition toward desired conditions at about the same rate as alternative B (modified) unless otherwise indicated below.

ROS/Suitability

The ROS classifications under alternative D would provide less Semi-primitive Non-motorized (215,325 acres compared to 206,592 acres) and less Primitive (5,365 acres compared to 14,098 acres) than alternative B (modified). Alternative D would provide more Semi-primitive Non-motorized (215,325 acres compared to 150,426 acres) and less Primitive (5,365 acres compared 96,249 acres) than alternative C. Alternative D would provide more Semi-primitive Non-motorized (215,325 acres compared to 117,974 acres) and less Primitive (5,365 acres compared 158,606 acres) than alternative A. Like alternatives B (modified) and C, alternative D would classify all of the designated wilderness acres managed by the Coconino NF) under the Wilderness Opportunity Spectrum (Transition = 19,299 acres, Semi-primitive = 37,205 acres, Primitive = 52,621 acres, Pristine = 42,205 acres, total acres = 151,330). Alternative D has the same number of acres classified in these ROS and WOS categories as alternative B (modified). Accordingly, the effects to soil condition would be the same as alternative B (modified).

Wilderness/RWA

There are no appreciable or measurable differences in plan direction for soils resources for alternatives B (modified), C and D with regard to wilderness areas and recommended wilderness areas. Alternative C recommends 13 new wilderness areas and 7 additional management areas. The focus would be on reducing motorized vehicle disturbance, reducing the amount of designated roads (allowing for administrative use or to be decommissioned), restricting the size of new camping corridors (Anderson Mesa, Blue Ridge, Knoll Lake, Hospital Ridge, Limestone, Second Chance and Pine Grove MAs), restricting grazing in RNAs, designating some areas as not suitable for recreational shooting and designating some management areas as semi-primitive non-motorized. However, these areas already exhibit very little soil disturbance caused from human activities. Consequently, the additional direction under alternative C is not expected to appreciable improve soil condition and productivity in these areas more than alternatives B (modified) and D.

All Riparian Forest Types and Wetlands

Alternative A

Riparian direction under alternative A is lacking or vague and does not provide clear direction to maintain or restore riparian areas toward maintaining or improving soil condition toward satisfactory condition or sustaining soil function where the soil has the ability to resist erosion, infiltrate water, and recycle nutrients. The current rate of implementation for soil improvement is low and centered largely on improving grazing strategies.

Without specific plan emphasis and objectives targeting this ERU, soil improvement (soil condition and productivity) for the remaining areas not in satisfactory condition under alternative A would be limited and would probably remain the same or static as it relates to movement toward desired conditions.

Alternatives B (modified), C, and D

For all riparian forest types (Cottonwood Willow Riparian, Montane Willow Riparian, and Mixed Broadleaf Deciduous Riparian) and Wetlands, alternatives B (modified), C, and D would include plan components that would move riparian areas toward identified desired conditions (FW-Rip-All-DC-1 to 5, FW-Rip-Wtlnds-DC-1 and 2, and FW-Rip- RipType-DC-1 to 6). In addition, a guideline directing identification of a vegetated aquatic management zone, maintenance of 80 percent herbaceous cover and limited and localized soil compaction and trampling of vegetation should be to the extent where permanent damage to perennial plants would not occur and result in the maintenance of soil cover, reduced sheet erosion, and improved nutrient cycling and soil productivity. The forestwide objective of restoration of 200 to 500 acres of any nonfunctional or functioning-at-risk riparian ERU within 10 years would treat and improve about twice as many acres as estimated in alterative A or 10 percent of total riparian areas forestwide and proportionally more per plan life of 15 years. For wetlands, the objective of restoration of 5 to 10 wetlands/10 years would improve at least 15 to 30 percent of total wetlands over 10 years and proportionally more per plan life of 15 years.

Under alternatives B (modified), C, and D, riparian vegetation and protective vegetative ground cover would increase and aid in the filtering of sediments, improve soil structure, improve nutrient cycling, improve water retention and groundwater recharge, and develop root masses that stabilize against cutting action associated with high waterflow, thereby reducing erosion, improving water quality and maintaining soil productivity. As a result, alternatives B (modified), C, and D would likely maintain or improve soil condition and productivity and move a large number of riparian areas to identified desired conditions more quickly than alternative A. Although implementing plan direction under alternatives B (modified), C, and D would move soils to desired conditions faster than alternative A, movement toward desired conditions would probably still be slow based on overall small numbers of acres identified for restoration in plan objectives.

Cottonwood Willow Riparian Forest

Alternative A

There is a high departure in the soil condition (92 percent) and high departure in soil productivity in this ERU riparian forest type. Most of the acreage that is departed occurs on stream terraces where most recreation use occurs. Under current management direction (including improved grazing strategies), overall soil condition and productivity would trend slowly toward desired conditions in most areas, including litter, vegetation composition, and understory composition. There are localized areas where the trend is away from desired conditions due to high recreation use (portions of Fossil Creek and other Verde River tributaries) or where improved cattle grazing strategies have not yet

been implemented. Current rate of implementation for soil improvement in this riparian forest type estimated to be low and largely done on an opportunity basis. Consequently, the goal of attaining all areas in satisfactory condition by 2020 is unlikely, as it would take decades to bring all soils into satisfactory condition.

Alternatives B (modified), C, and D

For all riparian forest types (Cottonwood Willow Riparian, Montane Willow Riparian, and Mixed Broadleaf Deciduous Riparian) and Wetlands, alternatives B (modified), C, and D would include plan components that would move riparian areas toward identified desired conditions (FW-Rip-All-DC-1 to 5, FW-Rip-Wtlnds-DC-1 and 2, and FW-Rip- RipType-DC-1 to 6). In addition, a guideline directing identification of a vegetated aquatic management zone, maintenance of 80 percent herbaceous cover and limited and localized soil compaction and trampling of vegetation should be to the extent where permanent damage to perennial plants would not occur and result in the maintenance of soil cover, reduced sheet erosion, and improved nutrient cycling and soil productivity. The forestwide objective of restoration of 200 to 500 acres of any nonfunctional or functioning-at-risk riparian ERU within 10 years would treat and improve about twice as many acres as estimated in alterative A or 10 percent of total riparian areas forestwide and proportionally more per plan life of 15 years. For wetlands, the objective of restoration of 5 to 10 wetlands per10 years would improve at least 15 to 30 percent of total wetlands over 10 years and proportionally more per plan life of 15 years.

Under alternatives B (modified), C, and D, riparian vegetation and protective vegetative ground cover would increase and aid in the filtering of sediments, improve soil structure, improve nutrient cycling, improve water retention and groundwater recharge, and develop root masses that stabilize against cutting action associated with high waterflow, thereby reducing erosion, improving water quality and maintaining soil productivity. As a result, alternatives B (modified), C, and D would likely maintain or improve soil condition and productivity and move a large number of riparian areas to identified desired conditions more quickly than alternative A. Although implementing plan direction under alternatives B (modified), C, and D would move soils to desired conditions faster than alternative A, movement toward desired conditions would probably still be slow based on overall small numbers of acres identified for restoration in plan objectives.

Montane Willow Riparian Forest

Alternative A

The soil condition in this riparian forest type is mostly satisfactory (about 78 percent with an additional 13 percent in satisfactory but inherently unstable condition) and soil productivity is similar to desired condition. There are some areas in Upper Clear Creek that probably have higher amounts of unsatisfactory soil conditions than the data suggest (Steinke, R., personal observations, 1989–2011). Under alternative A, both soil condition and productivity are projected to remain static relative to desired condition in the future. Litter, vegetation composition, and understory productivity are expected to remain about the same or improve in impaired or unsatisfactory soils that are minor in extent.

Alternative A's forestwide goal of attaining all areas in satisfactory condition may be possible for this riparian forest type since about 93 percent of this is already in satisfactory condition. However, current rate of implementation for soil improvement in this riparian forest type is low, largely done on an opportunity basis.

Alternatives B (modified), C, and D
For all riparian forest types (Cottonwood Willow Riparian, Montane Willow Riparian, and Mixed Broadleaf Deciduous Riparian) and Wetlands, alternatives B (modified), C, and D would include plan components that would move riparian areas toward identified desired conditions (FW-Rip-All-DC-1 to 5, FW-Rip-Wtlnds-DC-1 and 2, and FW-Rip- RipType-DC-1 to 6). In addition, a guideline directing identification of a vegetated aquatic management zone, maintenance of 80 percent herbaceous cover and limited and localized soil compaction and trampling of vegetation should be to the extent where permanent damage to perennial plants would not occur and result in the maintenance of soil cover, reduced sheet erosion, and improved nutrient cycling and soil productivity. The forestwide objective of restoration of 200 to 500 acres of any nonfunctional or functioning-at-risk riparian ERU within 10 years would treat and improve about twice as many acres as estimated in alterative A or 10 percent of total riparian areas forestwide and proportionally more per plan life of 15 years. For wetlands, the objective of restoration of 5 to 10 wetlands per 10 years would improve at least 15 to 30 percent of total wetlands over 10 years and proportionally more per plan life of 15 years.

Under alternatives B (modified), C, and D, riparian vegetation and protective vegetative ground cover would increase and aid in the filtering of sediments, improve soil structure, improve nutrient cycling, improve water retention and groundwater recharge, and develop root masses that stabilize against cutting action associated with high waterflow, thereby reducing erosion, improving water quality and maintaining soil productivity. As a result, alternatives B (modified), C, and D would likely maintain or improve soil condition and productivity and move a large number of riparian areas to identified desired conditions more quickly than alternative A. Although implementing plan direction under alternatives B (modified), C, and D would move soils to desired conditions faster than alternative A, movement toward desired conditions would probably still be slow based on overall small numbers of acres identified for restoration in plan objectives.

Mixed Broadleaf Deciduous Riparian Forest

Alternative A
This riparian forest type has a low departure from desired conditions is low and the projected trend is static for soil condition and productivity. Soil condition is mostly satisfactory (about 61 percent with an additional 8 percent that is satisfactory but inherently unstable). Most of the Mixed Broadleaf Deciduous Riparian forest type is located in areas with no motorized or livestock access and, therefore, has limited soil disturbance. Under alternative A, this is not projected to change.

Litter, vegetation composition, and understory productivity are expected to remain about the same or improve in impaired or unsatisfactory soils that are minor in extent. The current plan forestwide goal of attaining all areas in satisfactory condition may be possible since about 69 percent is already in satisfactory condition. However, current rate of implementation for soil improvement in this riparian forest type is low, largely done on an opportunity basis, and centered largely on improving grazing strategy and not mechanical treatments.

Alternatives B (modified), C, and D
For all riparian forest types (Cottonwood Willow Riparian, Montane Willow Riparian, and Mixed Broadleaf Deciduous Riparian) and Wetlands, alternatives B (modified), C, and D would include plan components that would move riparian areas toward identified desired conditions (FW-Rip-All-DC-1 to 5, FW-Rip-Wtlnds-DC-1 and 2, and FW-Rip- RipType-DC-1 to 6). In addition, a guideline directing identification of a vegetated aquatic management zone, maintenance of 80 percent herbaceous cover and limited and localized soil compaction and trampling of vegetation should be to the extent where permanent damage to perennial plants would not occur and result in the

maintenance of soil cover, reduced sheet erosion, and improved nutrient cycling and soil productivity. The forestwide objective of restoration of 200 to 500 acres of any nonfunctional or functioning-at-risk riparian ERU within 10 years would treat and improve about twice as many acres as estimated in alterative A or 10 percent of total riparian areas forestwide and proportionally more per plan life of 15 years. For wetlands, the objective of restoration of 5 to 10 wetlands per 10 years would improve at least 15 to 30 percent of total wetlands over 10 years and proportionally more per plan life of 15 years.

Under alternatives B (modified), C, and D, riparian vegetation and protective vegetative ground cover would increase and aid in the filtering of sediments, improve soil structure, improve nutrient cycling, improve water retention and groundwater recharge, and develop root masses that stabilize against cutting action associated with high waterflow, thereby reducing erosion, improving water quality and maintaining soil productivity. As a result, alternatives B (modified), C, and D would likely maintain or improve soil condition and productivity and move a large number of riparian areas to identified desired conditions more quickly than alternative A. Although implementing plan direction under alternatives B (modified), C, and D would move soils to desired conditions faster than alternative A, movement toward desired conditions would probably still be slow based on overall small numbers of acres identified for restoration in plan objectives.

Semi-desert Grassland

Alternative A

Soil condition and productivity in this ERU are classified as highly departed with a trend slowly toward desired conditions. This departure is due to historic and current grazing strategies, lack of fire, and improperly located roads. Historic management and weather conditions have led to a substantial increase in tree and shrub density. There is declined nutrient cycling, reduced ability to infiltrate water, and an inability of soil to resist erosion in about 95 percent of the ERU with impaired or unsatisfactory soil conditions. The remainder of the ERU has satisfactory but inherently unstable soil conditions.

Under alternative A, soil condition and productivity are projected to slowly move toward desired conditions as improved grazing strategies are implemented and roads are closed. Soil improvement would be slow due to the arid climate and lack of plan emphasis on treating this ERU. This trend would also be slowed due to the continued lack of fire. Under alternative A, litter, vegetation composition, and understory productivity are expected to remain static or trend away from desired condition in the absence of mechanical vegetation treatments to control encroaching undesirable trees and reintroduction of fire to this fire-adapted ERUs. In the absence of mechanical vegetation treatments, woody vegetation encroachment would continue, which reduces soil stability and results in increased soil erosion. The absence of fire would reduce nutrient cycling and nutrient releases that strongly influence soil chemical or physical properties, such as carbon and nitrogen ratios, phosphorus and potassium availability, aggregate stability, and soil profile organic matter.

The current rate of implementation for soil improvement in this ERU is very low and centered largely on improving grazing strategy and not mechanical treatments. Without specific plan emphasis and objectives targeting this ERU in alternative A, soil improvement would be very limited and slow.

Alternatives B (modified), C, and D

Alternative B (modified) has objectives to treat this ERU at a rate of 3,500 acres each 10-year period over the life of the plans, plus the overall forestwide soil objective of maintaining satisfactory soil condition and improving unsatisfactory or impaired soils on 100,000 to 350,000 acres within 10 years, although most of those acres would likely occur in the Ponderosa Pine ERU (FW-

TerrERU-Grass-O-1; FW-Soil-O-1). Since there are about 86,000 acres of impaired or unsatisfactory soils in the Semidesert Grassland ERU, it would take decades to treat all and reach desired conditions at this rate. Departure from reference condition would remain high with a slow trend toward desired conditions. However, if wildlife, fish, and plant objectives are implemented in this ERU, soil condition and productivity could be indirectly improved (FW-WFP-O-1, 2, 3).

A forestwide guideline has direction to develop project-specific guidance to avoid soil impacts when excessive ground disturbance on calcareous soils would churn highly erodible calcareous soil to the surface exposing it to high rates of wind erosion and surface infertility (FW-Soil-G-3). This is particularly relevant where calcareous soils occur within Semidesert Grassland ERU.

In addition, alternative B (modified) has desired conditions and a guideline specific to Semi-desert Grassland ERU that would promote stabilized and recovered arroyos and gullies, characteristic fire, and functioning soils (FW-TerrERU-Grass-DC-1, 2, and 5, FW-TerrERU-Grass-G-2).

Semi-desert Grassland ERU occurs within the Verde Valley, House Mountain-Lowlands, Red Rock, and Sedona Neighborwoods Management Areas in which there are desired conditions to manage the watersheds to reduce the risk of uncharacteristic flooding and sedimentation; to managed dispersed recreation so areas retain their natural character to the extent possible while in balance with other resources and maintaining or moving toward other desired conditions and watershed function; and these areas emphasize resource protection (MA-HouseMtn-DC-2; MA-RedRock-DC-2, 3; MA-SedN-DC-2; MA-VerdeV-DC-1,2, and G-1 and 2).

About 3,600 acres of Semi-desert Grassland is included in existing designated wilderness and about 132 acres occurs within Davey's recommended wilderness. According to the Vegetation and Fire Report (USDA Forest Service 2016c), wilderness designation typically limits active vegetation management and may have negative consequences with respect to meeting the ERU's vegetation or watershed desired conditions over the 132 acres in the long term. Designated and recommended wilderness is a relatively small proportion of this ERU, and thus, would have little effect on soil condition and productivity at the landscape level.

Under this alternative, wildfires may be managed for resource objectives in more areas of the landscape than in alternative A allowing increased opportunities to restore the natural fire regime (FW-TerrERU-All-G-2, FW-WUI-DC-4), which could improve soil condition and productivity where implemented.

A portion of Semidesert Grassland ERU occurs within the Verde Valley Botanical Area and the proposed Cottonwood Basin Botanical and Geological Area. Associated desired conditions for these special areas would sustain inherent physical and biological processes; and human activities, and permitted uses would not would not negatively impact these areas (SA-RNABotGeo-DC-5). Plan guidelines for botanical and geological areas would promote the use of minimal impact fire suppression tactics or other tactics and the development of special provisions in allotment management plans to protect the resources for which botanical areas were established (SA-RNABotGeo-G-2 and 4).

Collectively, implementing plan direction for alternative B (modified) would move Semidesert Grassland ERU toward desired conditions a little faster than alternative A. Treatments would increase protective vegetative ground cover and improve soil productivity and function. Consequently, water infiltrates and disperses properly, and soil withstands accelerated erosion and recycles nutrients. Herbaceous vegetative cover would be improved or maintained at levels that contribute to suitable hydrologic function, soil stability and nutrient cycling, and better adapt to

climate change. Compaction and erosion would be improved and minimized due to improved plant productivity.

In addition, alternative B (modified) could concentrate treatments to maintain satisfactory soil conditions and improve impaired and unsatisfactory soils, which could specifically improve this ERU, which has some of the poorest soil conditions of the forest.

Desert Communities

Alternative A

Soil condition and productivity in this ERU are classified as moderately departed with a static trend. There is declined nutrient cycling, reduced ability to infiltrate water, and an inability of soil to resist erosion in about 45 percent of the ERU with impaired or unsatisfactory soil conditions. The remainder of the ERU has satisfactory but inherently unstable soil conditions. Soil productivity is inherently very low overall with very low surface litter and very low understory and forage productivity due to its low elevation and arid climate.

Under alternative A, soil condition, including litter, vegetation composition, and understory productivity, is projected to retain a static trend over the next couple of decades due to high level of soil disturbance and limited annual precipitation received especially if drought persists. Current grazing strategies and restricted cross-country off-highway vehicle travel should very slowly move soil organics and vegetative production toward desired condition with normal precipitation. Soil conditions, however, would remain static with continued drought. The current rate of implementation for soil improvement in this ERU is very low and centered largely on improving grazing strategy and not mechanical treatments. Without specific plan emphasis and objectives targeting the Desert Communities ERU, soil improvement would be very limited, slow, and on an opportunity basis. Under alternative A, litter, vegetation composition, and understory productivity are expected to remain about the same over the short and long term.

Alternatives B (modified), C, and D

A forestwide guideline has direction to develop project-specific guidance to avoid soil impacts when excessive ground disturbance on calcareous soils would churn highly erodible calcareous soil to the surface exposing it to high rates of wind erosion and surface infertility (FW-Soil-3). This is particularly relevant where calcareous soils occur within Desert Communities ERU.

In addition, alternative B (modified) has desired conditions specific to Desert Communities that would promote stabilized and recovered arroyos and gullies, infrequent and localized uncharacteristic fires, and healthy soils (FW-TerrERU-DC-DC-1, 2, and 3). This alternative lacks treatment objectives specific to this ERU. However, if wildlife, fish, and plant objectives are implemented in this ERU, soil condition and productivity could be indirectly improved (FW-WFP-O-1, 2, 3).

Desert Communities ERU occurs within the Verde Valley, House Mountain-Lowlands, and Red Rock Management Areas in which there are desired conditions to manage the watersheds to reduce the risk of uncharacteristic flooding and sedimentation; to managed dispersed recreation so areas retain their natural character to the extent possible while in balance with other resources and maintaining or moving toward other desired conditions and watershed function; and these areas emphasize resource protection (MA-HouseMtn-DC-2; MA-RedRock-DC-2, 3; MA-VerdeV-DC-1,2, and G-1 and 2).

A portion of Desert Communities occurs within the Verde Valley Botanical Area and the proposed Cottonwood Basin Botanical and Geological Area. Associated desired conditions for these special

areas would sustain inherent physical and biological processes; and human activities, and permitted uses would not would not negatively impact these areas (SA-RNABotGeo-DC-5). Plan guidelines for botanical and geological areas would promote the use of minimal impact fire suppression tactics or other tactics and the development of special provisions in allotment management plans to protect the resources for which botanical areas were established (SA-RNABotGeo-G-2 and 4).

Collectively, these plan components would maintain or improve soil condition and productivity when implemented which should result in very slow improvement over the plan life as alternative B (modified) plan direction is applied to projects and activities. Soil improvement would be slow due to the arid climate and lack of plan emphasis objectives to specifically treat this ERU.

Interior Chaparral

Alternative A

Soil condition and productivity in this ERU have a low departure with a static trend. Soil is functioning properly and normally. About 11 percent of the ERU is in satisfactory condition, while the remainder of the ERU has satisfactory but inherently unstable soil conditions.

Under alternative A, soil condition and productivity are projected to remain static. Litter, vegetation composition, and understory productivity are expected to remain about the same. The goal of attaining all areas in satisfactory condition has, for the most part, already been attained. Alternative A has no desired conditions, objectives, guidelines, and standards for soils and for this ERU. It lacks clear direction to manage interior chaparral vegetation toward maintaining or improving soil condition toward satisfactory condition or sustaining soil function where the soil has the ability to resist erosion, infiltrate water and recycle nutrients. According to the Vegetation and Fire Report (USDA Forest Service 2016c), continued management at current levels over the long term could lead to a decline in vegetative structure and composition as weed presence is expected to expand and fire suppression objectives prevent fire from playing its natural role in the ERU. Consequently, soil condition and productivity could decline over the long term.

Alternatives B (modified), C, and D

From a soil condition and productivity standpoint, the identified desired conditions have, for the most part, already been met and the trend is toward desired conditions. No specific plan objectives are needed or included in alternative B (modified) to maintain soil productivity in this ERU. Implementing direction for desired conditions in alternative B (modified) would emphasize maintenance of vegetative ground cover. Sufficient protective vegetative ground cover (35 to 45 percent) would be maintained to protect soil from accelerated erosion and, therefore, would maintain soil productivity. Soil nutrient cycling would be improved through maintenance of biological soil crusts. There is a guideline that directs fire treatments to maintain diversity of habitat and plant community in seral stages that would indirectly improve soil nutrient cycling and reduce the risk of moderate severity wildfires that may pose risk to soil productivity, connected waters, and water quality. However, according to the Vegetation and Fire Report (USDA Forest Service 2016c), the presence and increase of invasive species could reinforce the trend away from desired conditions with respect to vegetation structure and composition. Fire return interval is expected to remain moderately departed and trending away from the desired conditions. Under this alternative, the trends away from the desired condition may be mitigated as wilderness (which represents 76 percent of this ERU) is prioritized for invasive species control (Management Approaches for Invasive Species). Conditions may also improve by managing wildfires for resource objectives when burning conditions permit (FW-TerrERU-All-G-2), an option that was not available within wildland-urban interface under alternative A.

In addition, alternative B (modified) has desired conditions and a guideline specific to Interior Chaparral ERU that would protect soils through maintaining vegetation and litter cover and rotating treatment locations and would promote the control of invasive plants so they do not alter the fire regime (FW-TerrERU-IC-DC-3 and 4, FW-TerrERU-IC-G-1). An altered fire regime in the Interior Chaparral ERU would have potential to cause an increase soil erosion rates).

Interior Chaparral ERU occurs primarily within the Red Rock MA, but also in Pine Belt, Oak Creek Canyon, Verde Valley, Sedona Neighborwoods and House Mountain-Lowlands Management Areas. These management areas have desired conditions to manage the watersheds to reduce the risk of uncharacteristic flooding and sedimentation; to manage dispersed recreation so areas retain their natural character to the extent possible while in balance with other resources and maintaining or moving toward other desired conditions and watershed function; and these areas emphasize resource protection (MA-HouseMtn-DC-2; MA-RedRock-DC-2, 3; MA-SedN-DC-2; MA-OakCrk-DC-3, MA-VerdeV-DC-1,2, and G-1 and 2).

There are no acres of Interior Chaparral in recommended wilderness.

Under this alternative, wildfires may be managed for resource objectives in more areas of the landscape than in alternative A allowing increased opportunities to restore the natural fire regime (FW-TerrERU-All-G-2, FW-WUI-DC-4), which could improve soil condition and productivity where implemented.

Implementing additional plan direction under alternative B (modified) would better assure soil condition and productivity are maintained and moving toward desired conditions compared to alternative A.

Pinyon-Juniper Types (Pinyon-Juniper with Grass, Pinyon-Juniper Evergreen Shrub, and Pinyon-Juniper Woodland)

Alternative A

Soil condition and productivity in Pinyon-Juniper with Grass have a low departure with a trend away from desired conditions. Lack of fire has contributed to the development of areas with high canopy cover and loss of herbaceous understory. Herbaceous understory helps hold soil in place and carries fire. There is declined nutrient cycling, reduced ability to infiltrate water, and an inability of soil to resist erosion in about 28 percent of the ERU with impaired or unsatisfactory soil conditions especially where the canopy is more than about 30 to 40 percent. The remainder of the ERU has satisfactory or satisfactory but inherently unstable soil conditions. Many areas are eroding faster than they are renewing themselves putting soil productivity at risk. It takes dozens of years to build one inch of soil in this ERU. Overall, soil condition is projected to move slowly away from reference condition except in areas where the trees have been thinned. In thinned areas, soil condition should move toward reference condition with the return of an herbaceous understory.

Soil condition and productivity in Pinyon Juniper Evergreen Shrub are moderately departed with a trend away from desired conditions. Lack of fire has contributed to the development of areas with high canopy cover and loss of herbaceous understory. Herbaceous understory helps hold soil in place and carries fire. There is declined nutrient cycling, reduced ability to infiltrate water, and an inability of soil to resist erosion in about 57 percent of the ERU with impaired soil conditions especially where the canopy is more than about 30 to 40 percent. The remainder of the ERU has satisfactory or satisfactory but inherently unstable soil conditions.

Soil condition and productivity in Pinyon Juniper Woodland are moderately departed with a trend away from desired conditions. Due to rockier and droughty soils and subsequent reduced herbaceous vegetative layer, the Pinyon Juniper Woodland ERU is less likely to carry a surface fire and more likely to contain older, denser tree stands than the other pinyon juniper types. In some portions of the ERU, lack of fire has also contributed to the development of tree canopy cover above about 30 percent, which would reduce herbaceous understory, vegetative ground cover and soil condition and productivity. There is declined nutrient cycling, reduced ability to infiltrate water, and an inability of soil to resist erosion in about 60 percent of the ERU with impaired soil conditions. The remainder of the ERU has satisfactory or satisfactory but inherently unstable soil conditions.

For all three pinyon juniper types, Alternative A has a goal to put all soils in satisfactory soil condition that are currently not in satisfactory soil condition by year 2020. Implementation rates for tree reduction and soil improvement is low. There are no specific treatment objectives in the 1987 plan. Improvements are centered largely on improving grazing strategy and there have been only limited mechanical treatments. Consequently, soil improvement would be slow, limited and on an opportunity basis due to the arid climate and lack of plan emphasis on treating this ERU. Improvement would also be slowed due to insufficient fire.

Current management, treatment rates are about 900 acres per year or 0.003 percent of the ERU per year. At this rate, it would take over 100 years to thin or improve all unsatisfactory and impaired soils. Many areas are eroding faster than they are renewing themselves putting soil productivity at risk. It takes dozens of years to build 1 inch of soil in this ERU. Overall, soil condition is projected to move slowly away from desired condition as tree cover continues to increase reducing herbaceous understory and soil condition and productivity except in areas where the trees have been thinned. In thinned areas, soil condition should move toward desired condition with the return of an herbaceous understory.

Alternatives B (modified), C, and D

Alternative B (modified) has objectives to mechanically treat between 1,000 and 10,000 acres of Pinyon-Juniper with Grass ERUs (see table 1) during each 10-year period over the life of the plan plus use naturally ignited wildfire to treat at least 3,750 acres of Pinyon Juniper with Grass and 3,750 acres of Pinyon Juniper Evergreen Shrub within the natural fire regime during each 10-year period over the life of the plan. In addition, there is an the overall forestwide soil objective of maintenance and improvement of soil condition on 100,000 to 350,000 acres during each 10-year period over the life of the plan, although most of those acres would likely occur in the Ponderosa Pine ERU. Since there are over 268,000 acres of impaired or unsatisfactory soils in these ERUs, it would take decades to treat all and reach desired conditions, however, all three pinyon juniper types are expected to slowly trend toward desired conditions.

Pinyon Juniper with Grass would be expected to slowly trend toward desired conditions in the short term, with a faster rate under the higher mechanical treatment objective. Over time, regeneration would be expected to fill in the openings and canopies would continue to close, reducing the understory, and consequently losing the improvement to soil condition and productivity. In the long term, the trend would be static under the higher treatment objective, and would slowly move away under the lower treatment objective.

Desired conditions would require vegetation management and natural disturbances to develop sufficient organic ground cover and native herbaceous vegetation that protects soil from accelerated erosion and compaction (FW-TerrERU-PJ-DC-3, 4, 8, 9, 13, and 14). Managing ground cover and tree density to meet these desired outcomes would improve soil condition trend and move these

ERUs slowly toward desired conditions, whereas alternative A would trend away due to lack of treatment emphasis.

In addition, alternative B (modified) has a guideline specific to pinyon juniper ERUs that would design slash treatments to improve herbaceous vegetation growth, watershed condition, and soil productivity (FW-TerrERU-PJ-G-2).

Under this alternative, wildfires may be managed for resource objectives in more areas of the landscape than in alternative A allowing increased opportunities to restore the natural fire regime (FW-TerrERU-All-G-2, FW-WUI-DC-4), which could improve soil condition and productivity where implemented.

About 4,200 acres (1.6 percent of ERU) of Pinyon Juniper with Grass is included in existing designated wilderness and about 3,600 acres (1.4 percent of ERU) occurs within the Strawberry Crater recommended wilderness. About 47,893 acres (18.2 percent of ERU) of Pinyon Juniper Evergreen Shrub is included in existing designated wilderness and about 723 acres (0.3 percent of ERU) occurs within Davey's recommended wilderness.

About 5,200 acres (6.9 percent of ERU) of Pinyon Juniper Woodland is included in existing designated wilderness and about 1,467 acres (1.9 percent of ERU) is included in Davey's and Strawberry Crater recommended wilderness areas. While the proposed forest plan direction for managing wilderness areas makes mechanical treatments unlikely to occur, the cinder soil type within these locations and lack of understory vegetation make wildfires less likely. Taken in combination, the relatively small area and the low likelihood of wildfire suggest that the recommended wilderness area would have little effect on vegetation or fire return interval departure

According to the Vegetation and Fire Report (USDA Forest Service 2016c), wilderness designation typically limits active vegetation management and may have negative consequences with respect to meeting the ERU's vegetation or watershed desired conditions over the 3,600 acres in the long term. Combined, designated and recommended wilderness constitute a relatively small proportion of this ERU, and thus, recommendation would have little effect on soil condition and productivity at the landscape level.

Under this alternative, wildfires may be managed for resource objectives in more areas of the landscape than in alternative A, allowing increased opportunities to reduce the risk of uncharacteristic fire and to restore fire-adapted ecosystems (FW-TerrERU-All-G-2, FW-WUI-DC-4), which could improve soil condition and productivity where implemented.

Therefore, implementing plan direction for alternatives B (modified), C, and D would move these ERUs slowly toward desired conditions. In areas treated, the following scenario would occur, protective vegetative ground cover would increase, soil productivity and function would improve and function normally and properly so water infiltrates and disperses properly, withstands accelerated erosion, and recycles nutrients. Herbaceous vegetative cover would be improved or maintained at levels that contribute to suitable hydrologic function, soil stability, and nutrient cycling and better adapt to climate change. Compaction and erosion would be minimized due to improved plant productivity.

Alternative A does not have ERU-specific objectives and soil improvement would occur only on an opportunity basis, likely far less than in alternatives B (modified), C, and D and, based on recent trends, would continue to move away from desired conditions. Under alternative A, soil condition would not improve as quickly as implementing plan direction in alternatives B (modified), C, and D.

In addition, alternatives B (modified), C, and D concentrate treatments in focus watersheds on needed soil improvement, which allow a better opportunity for restoring or maintaining watershed and soil condition in these ERUs because these ERUs have some of the poorest soil conditions of the forest.

ERU-specific direction for all pinyon-juniper types in these alternatives direct presence of sufficient plant litter and coarse woody material to resist accelerated erosion and essential to promote nutrient cycling (USDA Forest Service 1994) and water retention that should result in maintenance and improvement of soil condition and productivity. In addition, biological soils crusts would be present to improve nutrient cycling and stabilize soils.

Implementing plan direction for alternatives B (modified), C, and D would result in soil improvement projects including mechanical thinning, lop and scatter, treatment of encroached grasslands, maintenance of previously converted areas on grassland soil types, and reduction of hazardous fuels through prescribed or wildfires managed for resource objectives that would result in improved herbaceous understory biomass, protective vegetative ground cover, reduced soil erosion, and improved soils. For the Pinyon-Juniper Evergreen Shrub ERU, implementing direction for alternatives B (modified), C, and D includes greater emphases on use of wildfire to meet resource objectives. This should result in a reduction of hazardous fuels that pose risk to watershed condition and water quality from potential uncharacteristic wildfires that generally result in large areas of high burn severity.

Forestwide, implementation of plan direction in alternatives B (modified), C, and D would equally move and at the same rate the soil resource to the identified desired conditions. Overall, compared to alternative A, implementing management direction in alternatives B (modified), C, and D would equally improve the ability of the soil to resist erosion, infiltrate water, and recycle nutrients. Under alternative A, soil condition and productivity would probably move away from, whereas alternatives B (modified), C, and D would move slowly toward desired conditions.

Ponderosa Pine

Alternative A

Soil condition and productivity in Ponderosa Pine have a low departure with a static trend relative to desired conditions. Although the forest is overstocked and herbaceous understory reduced compared to desired conditions, the amount of protective duff layer is more than adequate to protect against accelerated erosion and loss of soil productivity. Because herbaceous understory is somewhat reduced, nutrient cycling is nearly impaired. The risk of wildfire resulting in large areas of high burn severity can be high during spring and summer months that could result in appreciable loss of soil and productivity and risk degradation of water quality along connected streams. There is declined nutrient cycling, reduced ability to infiltrate water, and an inability of soil to resist erosion in only about 1 percent of the ERU with unsatisfactory soil conditions. The remainder of the ERU has satisfactory soil conditions.

Projected implementation rates for mechanical thinning in this ERU are similar to plan objectives in alternatives B (modified), C and D, that is, prescribed cutting would be used to treat 50,000 to 260,500 acres of ponderosa pine during each 10-year period over the life of the plan. This represents about 6 percent of the ERU at the low end of the range and about 33 percent of the ERU at the high end of the range. Fires managed for resource objectives would treat at least 135,000 acres per 10 years and between 150,000 to 200,000 acres per 10 years would be treated with prescribed fire.

Overall, soil condition and productivity is projected to remain static. In open areas, or areas that are treated, herbaceous understory and nutrient cycling function would improve to satisfactory condition and move toward desired conditions but remain static in untreated areas. Where dense trees and high canopy closures occur in untreated areas, vulnerability to uncharacteristic wildfire would persist. High burn severity fires would pose a risk to soil condition and watershed condition in areas where soils have a moderate to high erosion hazard, which account for nearly a third of the ERU.

Litter, vegetation composition, and understory productivity are expected to remain about the same. The goal of attaining all areas in satisfactory condition has, for the most part, already been attained. Current implementation of hazardous fuel reduction is moving these ERU toward vegetative desired conditions and improving herbaceous understory along with soil condition and productivity.

Alternatives B (modified), C, and D

Plan objectives in Ponderosa Pine are the same as planned implementation rates in Alternative A with similar consequences (FW-TerrERU-PP-O-1,2,3).

Overall, soil condition and productivity is projected to improve faster with the higher mechanical thinning objective at both 15 and 50 years. Openness would increase by about 8 percent in the short term and by about 12 percent in the long term compared to existing (USDA Forest Service 2016c). With the low objective, the amount of treatment would not keep pace with ongoing growth and canopy closure over the short term and openness would decrease by 4 percent; however, over the long term, it would increase by about 1 percent compared to existing.

In open areas, or areas that are treated, herbaceous understory and nutrient cycling function would improve to satisfactory condition and move toward desired conditions but remain static in untreated areas. Where dense trees and high canopy closures occur in untreated areas, vulnerability to uncharacteristic wildfire would persist. High burn severity fires would pose a risk to soil condition and watershed condition in areas where soils have a moderate to high erosion hazard, which account for nearly a third of the ERU.

Even though this ERU is dominated by satisfactory soil conditions, additional maintenance is required to improve nutrient cycling and reduce the risk of uncharacteristic wildfires that pose a risk to soil productivity and water quality.

Implementing plan direction for alternative B (modified) would move this ERU even closer toward desired conditions compared to alternative A. In areas treated, the following scenario would occur, soil productivity and function would improve even within the satisfactory condition class and function normally and properly so water infiltrates and disperses properly, withstands accelerated erosion, and recycles nutrients. Herbaceous vegetative cover would be improved or maintained at levels that contribute to suitable hydrologic function, soil stability and nutrient cycling, and better adapt to climate change. Compaction and erosion would be minimized due to plant diversity.

In addition, alternatives B (modified), C, and D concentrate treatments in focus watersheds needed soil improvement, which allow a better opportunity for restoring or maintaining watershed and soil condition in this ERU because there is high emphasis to treat this ERU due to high wildfire risk and potential for increased biomass production that may contribute to local economic sustainability.

In addition, desired conditions for alternative B (modified) would emphasize maintenance of vegetative groundcover sufficient to protect soil against accelerated erosion, promote water infiltration, and maintain woody material that contributes to long-term soil productivity (FW-TerrERU-PP-DC-2). Alternative B (modified) would promote characteristic fire and natural and

human disturbances at levels that would maintain coarse woody debris and nutrient cycling resulting in lower risk to downstream water quality and the maintenance of soil productivity. (FW-TerrERU-PP-DC-3,5). Diversity of understory species (e.g., grasses, forbs, and shrubs) is within the capability of the site and would provide for infiltration of water and soil stability (FW-TerrERU-PP-DC-10).

Implementing direction for alternatives B (modified), C, and D would result in soil improvement projects including mechanical thinning and reduction of hazardous fuels through prescribed or wildland fires to meet resource objectives that would result in improved herbaceous understory biomass, protective vegetative groundcover, reduced soil erosion, and improved soil. The greater emphasis on the use of fire to meet resource objectives in alternatives B (modified), C, and D should also result in a reduction of hazardous fuels that pose risk to watershed condition and water quality from potential uncharacteristic wildfires that generally result in large areas of high burn severity.

Implementing plan direction would reduce hazardous fuels and associated risk of high burn severity stemming from overstocked forests and woodlands and, consequently, would reduce the risk of accelerated erosion and sediment delivery into connected stream courses, thus maintaining water quality.

Implementing desired conditions and objectives under alternatives B (modified), C, and D that lower tree density could cause a short-term increase in water yield to connected streamcourses, springs, and groundwater, but this would be expected to last less than 10 years according to research (USDA Forest Service 1979).

About 31,086 acres (3.9 percent of ERU) of Ponderosa Pine is included in existing designated wilderness and about 97 acres (less than 1 percent of ERU) occurs within the Abineau recommended wilderness.

Implementing management direction in alternatives B (modified), C, and D would equally maintain or improve the ability of the soil to resist erosion, infiltrate water, and recycle nutrients. Under alternative A, soil condition and productivity would remain static or not improve as quickly as implementing plan direction in alternatives B (modified), C, and D.

Mixed Conifer Types

(Mixed Conifer with Frequent Fire and Mixed Conifer with Infrequent Fire)

Alternative A

Soil condition and productivity in both mixed conifer types have a low departure with a static trend relative to desired conditions. Both ERUs have 100 percent satisfactory soil conditions.

Under alternative A, projected implementation rates for mechanical thinning in MCFF could treat the same (at the low end) or fewer acres per year (at the high end) as alternatives B (modified), C and D, that is, prescribed cutting would be used to treat 2,900 to 8,900 acres of MCFF during each 10-year period over the life of the plan. This represents about 6 percent of the ERU at the low end of the range and about 30 percent of the ERU at the high end of the range. Fires managed for resource objectives would treat at least 7,500 acres per 10 years and at least 8,000 acres per 10 years would be treated with prescribed fire. There are no projected implementation rates for Mixed Conifer with Infrequent Fire.

The projected future trends for both soil condition and productivity in both mixed conifer types are static since litter, vegetation composition, and understory productivity are expected to remain about

the same. Alternative A 's forestwide goal of attaining all areas in satisfactory condition has, for the most part, already been attained.

In Mixed Conifer with Frequent Fire, the fire regime is believed to be more frequent than in Mixed Conifer with Infrequent Fire, thus, it more closely resembles the Ponderosa Pine ERU with respect to potential degradation of soil condition and productivity. Where dense stands and high canopy cover occur within either mixed conifer type, there is an increased vulnerability to uncharacteristic fire. This would pose increased risk to connected waters and water quality in the event of a large wildfire. High burn severity fires pose a risk to soil condition and watershed condition in areas where soils have a moderate to high erosion hazard, which account for more than half of these ERUs. There would be less improvement of the herbaceous understory vegetation and soil nutrient cycling function at the low range of mechanical treatment in Mixed Conifer with Frequent Fire and more improvement at the high end of the range.

Alternatives B (modified), C, and D

For Mixed Conifer with Frequent Fire, alternatives B (modified), C, D have plan desired conditions and objectives to use low-severity fire in the frequent fire ERU on up to 8,000 acres per 10 years and 7,500 acres per 10 years for wildfires managed to meet resource objectives, plus the overall forestwide soil objective of maintenance and improvement of soil condition on 100,000 to 350,000 acres within 10 years, although most of those acres would likely occur in the Ponderosa Pine ERU. Recent soil condition and productivity trend is static because the soil surface has adequate ground cover to reduce accelerated erosion. However, implementing plan direction for alternatives B (modified), C, and D would improve soil nutrient cycling and, although slowly, would move conditions toward identified desired conditions better than alternative A. In areas treated with fire, soil productivity and function would improve even within the satisfactory condition class and function normally and properly so water infiltrates and disperses properly, withstands accelerated erosion, and recycles nutrients. Herbaceous vegetative cover would be improved or maintained at levels that contribute to suitable hydrologic function, soil stability and nutrient cycling, and better adapt to climate change. Compaction and erosion would be minimized due to plant diversity.

In addition, implementing direction for desired conditions in alternatives B (modified), C, and D would emphasize maintenance of vegetative ground cover sufficient to protect soil against accelerated erosion, promote water infiltration, and maintain coarse woody material that contributes to long-term soil productivity (USDA Forest Service 1994). Alternatives B (modified), C, and D would strive to create a landscape where low-severity wildfires are characteristic for the ERU (high-severity wildfires could occur on a rare basis in Mixed Conifer with Infrequent Fire) resulting in lower risk to downstream water quality and maintenance of soil productivity.

Implementing direction for alternatives B (modified), C, and D (reduction of hazardous fuels) through prescribed or wildfires managed to meet resource objectives would result in improved herbaceous understory biomass, protective vegetative ground cover, reduced soil erosion, and improved soil. Allowing low-severity fire plays a large role and should result in improved herbaceous understory growth improving soil condition and productivity and a reduction of hazardous fuels that pose risk to watershed condition and water quality from potential uncharacteristic wildfires that generally result in large areas of high burn severity.

There are no acres of Mixed Conifer Frequent Fire in recommended wilderness.

About 8,193 acres (22 percent of ERU) of Mixed Conifer with Infrequent Fire is included in existing designated wilderness and about 347 acres (less than 1 percent of ERU) occurs within the Abineau recommended wilderness.

Overall, compared to alternative A, implementing management direction in alternatives B (modified), C, and D would equally maintain or improve the ability of the soil to resist erosion, infiltrate water, recycle nutrients, and slowly move soil condition toward identified desired conditions. Under alternative A, soil condition and productivity would remain static or not improve as quickly as implementing plan direction in alternatives B (modified), C, and D.

The desired conditions related to soil condition and productivity for Mixed Conifer with Infrequent Fire ERU are similar to Mixed Conifer with Frequent Fire. In the plan direction for this ERU and elsewhere, there is improved direction for aspen in alternatives B (modified), C, and D; however, compared to alternative A, that better clarifies where aspen should generally be found and its role on the landscape.

Great Basin Grassland

Alternative A

Soil condition in Great Basin Grassland is highly departed with a slow trend toward desired conditions. Soil productivity is moderately departed with slow trend toward desired conditions. with a static trend. With normal precipitation, surface litter, understory and forage vegetation production, and soil organic matter would improve. Elk grazing, however, may reduce the rate of improvement to a limited extent. There is declined nutrient cycling, reduced ability to infiltrate water, and an inability of soil to resist erosion in about 87 percent of the ERU with unsatisfactory or impaired soil conditions. The remainder of the ERU has satisfactory soil conditions.

Under alternative A, soil condition and productivity are projected to move slowly toward reference condition. Current rate of implementation for soil improvement in this ERU is low and centered largely on improving grazing strategy and few mechanical treatments.

Alternatives B (modified), C, and D

Alternatives B (modified), C, and D have objectives to treat between 10,800 and 12,400 acres during the 10 years following plan approval that would assure that soil condition function is improved and soil productivity maintained on those acres. Overall, the amount of acres that would be treated is 11.6 to 13 percent of total ERU acres, but the result would move these acres toward identified desired conditions equally but faster than alternative A.

About 190 acres (less than 1 percent of ERU) of Great Basin Grassland is included in existing designated wilderness and about 2,327 acres (2.5 percent of ERU) occurs within the Strawberry Crater recommended wilderness.

Montane/Subalpine Grassland

Alternative A

In the montane portion of Montane/Subalpine Grassland, soil condition is highly departed with a static trend. Soil productivity is moderately departed with a static trend because two of the productivity characteristics, surface litter and herbaceous production, are classified as low to moderate and are departed from reference conditions. Historic and continued grazing by livestock and wildlife has contributed to the development of areas with reduced soil productivity in the montane grassland portion. There is declined nutrient cycling, reduced ability to infiltrate water, and an inability of soil to resist erosion in about 69 percent of the ERU with impaired soil conditions. The remainder of the ERU has satisfactory soil conditions.

Under alternative A, soil condition and soil productivity are expected to remain static due to continued grazing, especially by elk. The few areas that are excluded from grazing would trend toward reference conditions.

In the subalpine portion of Montane/Subalpine Grassland (TES unit 640), soil condition and soil productivity have a low departure with a static trend. Litter, understory and forage production are near reference conditions. Under alternative A, soil condition and soil productivity are expected to remain static and soil productivity is expected to remain high.

The current rate of implementation for soil improvement in this ERU is very low and centered largely on improving grazing strategy and not mechanical treatments. Without specific plan emphasis and objectives targeting this ERU, soil improvement would be very limited, slow, and on an opportunity basis.

Alternatives B (modified), C, and D

Alternatives B (modified), C, and D have objectives to specifically treat this ERU. In addition, alternatives B (modified), C, and D have a forestwide objective of maintenance and improvement of soil condition on 100,000 to 350,000 acres within 10 years. Most of the improvements would probably occur in the Ponderosa Pine ERU, but some could be targeted in this ERU.

Alternatives B (modified), C, and D have objectives to treat between 7,600 and 11,400 acres for the 10 years following plan approval that would assure that soil condition function is improved and soil productivity maintained on those acres. Overall, the amount of acres that would be treated is between 32 and 48 percent of total ERU acres, but the result would move these acres toward identified desired conditions equally but faster than alternative A. Alternatives B (modified), C, and D have additional guidelines directing maintenance of at least 90 percent protective vegetative ground cover that would protect against accelerated erosion and maintain soil productivity. Since there are only about 16,000 acres of impaired soils in this ERU, it would be possible to treat most of the ERUs over the life of the plan and reach identified desired conditions. Given alternatives B (modified), C, and D have additional plan components directing treatment of impaired and unsatisfactory soils such that they are trending toward satisfactory soil conditions, implementing plan direction for alternatives B (modified), C, and D would move these ERUs slowly toward desired conditions. In areas treated, soil productivity and function would improve and function normally and properly so that water infiltrates and disperses properly, withstands accelerated erosion, and recycles nutrients. Herbaceous vegetative cover would be improved or maintained at levels that contribute to suitable hydrologic function, soil stability and nutrient cycling, and better adapt to climate change. Compaction and erosion would be improved and minimized due to improved plant productivity.

In addition, alternatives B (modified), C, and D could concentrate treatments in focus watersheds needing soil improvement, which allow a better opportunity for restoring or maintaining watershed and soil condition in these ERUs because these ERUs have some of the poorest soil conditions of the forest.

Implementing direction for alternatives B (modified), C, and D would result in soil improvement projects including mechanical thinning with lop and scatter, herbicide, or prescribed fire treatments of invaded woody species that would have the following indirect consequences; would result in improved herbaceous understory biomass, protective vegetative ground cover, reduced soil erosion, improved water quality, and soil productivity.

In addition, implementing plan direction in alternatives B (modified), C, and D would require maintenance of ground cover and herbaceous vegetation sufficient to protect from accelerated

erosion and promote water infiltration and nutrient cycling function. Soil function would be sustained. When implemented, the guideline to maintain at least 40 percent vegetative ground cover would adequately protect soil against accelerated erosion and maintain soil productivity.

No acres of Montane Subalpine Grassland are included in recommended wilderness.

Spruce-Fir

Alternative A
Soil condition and productivity in Spruce-Fir have a low departure with a static trend. The ERU has satisfactory or satisfactory but inherently unstable soil conditions.

This ERU is located primarily within the Kachina Peaks Wilderness Area and Kendrick Mountain Wilderness Area. The satisfactory soil conditions (over 90 percent) are little changed between historic and current conditions. These soils have high amounts of vegetative ground cover to prevent accelerated erosion. Likewise, soil productivity is similar to reference conditions. Soil is functioning normally, and maintaining levels necessary to sustain ecological systems.

Under the current plan and applicable components, soil condition and productivity are projected to remain static. Litter, vegetation composition, and understory productivity are expected to remain about the same. The goal of attaining all areas in satisfactory condition has for the most part, already been attained.

Alternatives B (modified), C, and D
From a soil condition and productivity standpoint, the identified desired conditions have, for the most part, already been met. No specific plan objectives are needed or included in the revised plan alternatives B (modified), C, and D to maintain soil productivity. There is, however, a guideline that directs minimal and confined soil and vegetation disturbance from management activities to maintain soil productivity and 6th HUC watershed condition in class 1 (functioning condition).

Implementing direction for desired conditions in alternatives B (modified), C, and D would emphasize maintenance of vegetative ground cover sufficient to protect soil against accelerated erosion, promote water infiltration, and maintain coarse woody material that contributes to long-term soil productivity (USDA Forest Service 1994). Alternatives B (modified), C, and D would strive to create a landscape where mixed and some high-severity wildfires are characteristic for the ERU and function to maintain stand density, structure, and plant composition. High-severity fires could infrequently occur but not to the extent where it would risk long-term impairment to connected waters downstream or cause loss of productivity over major portions of the 5th or 6th HUC watershed.

Because almost all soils in this ERU are in satisfactory condition, alternatives B (modified), C, and D would continue to maintain soil condition in satisfactory condition and maintain soil productivity similar to current conditions (alternative A).

No acres of Spruce-Fir are included in recommended wilderness.

Alpine Tundra

Alternative A
This ERU is located entirely within the Kachina Peaks Wilderness Area. It has low departure from desired condition (soils are either satisfactory or satisfactory and inherently unstable) for both soil condition and soil productivity and are projected to remain static. Litter, vegetation composition, and

understory productivity are expected to remain about the same. The goal of attaining all areas in satisfactory condition has for the most part, already been attained and is expected to be maintained under alternative A.

Alternatives B (modified), C, and D

From a soil condition and productivity standpoint, the identified desired conditions have, for the most part, already been met. No specific plan objectives or guidelines are needed or included in the revised plan alternatives B (modified), C, and D to maintain soil productivity.

Forestwide soil desired conditions stated alternatives B (modified), C, and D would continue to maintain soil condition in satisfactory condition, maintain soil productivity similar to alternative A and, therefore, trends would also be expected to be static.

No acres of Alpine/Tundra are included in recommended wilderness.

Cumulative Effects

See the cumulative effects discussion in the Watersheds and Water section above.

Biophysical Features

Geological Features

Affected Environment

Caves and Karst Terrain and Resources

The Coconino NF has many caves,[27] most of which are only well known by local cavers. The forest has a range of cave and karst[28] types including lava tube caves, bedrock collapse sinkhole caves, or sinking stream caves and dry caves in limestone/dolomite, gypsum and even sandstone bedrock. Pseudokarst found on the forest includes lava tubes and collapsed lava tubes, badlands and piping pseudokarst and crevice and talus pseudokarst. Most of the lava tube caves are found on the Flagstaff Ranger District associated with basaltic lava flows. Caves developed in karst terrain are found on the Mogollon Rim, Flagstaff, and Red Rock District and are developed in the Kaibab Limestone Formation. Bedrock collapse sinkholes are found in the surficial bedrock (Hermit Formation) in the Sedona area, which formed from the collapse of large water-filled underground cave systems developed in the Redwall Limestone (Lindberg 2010). There are even caves located in the Verde Valley associated with the Verde Valley Formation sediments that contain gypsum and other soluble minerals. The forest also has many karst features called resurgences, which are the re-emergence of karst groundwater where a part of or all of the water is derived from surface inflow into sink holes at higher levels. Resurgences are a karst term for springs in karst terrain.

[27] The Federal Cave Resources Protection Act defines “cave” as any naturally occurring void, cavity, recess, or system of interconnected passages which occurs beneath the surface of the Earth or within a cliff or ledge (including any cave resource therein, but not including any vug, mine, tunnel, aqueduct, or other manmade excavation) and which is large enough to permit an individual to enter, whether or not the entrance is naturally formed or manmade. Such term shall include any natural pit, sinkhole, or other feature which is an extension of the entrance.

[28] Terrain created by the chemical solution of the bedrock, including carbonate rocks, gypsum, and to a minor extent on other rocks, and characterized by disrupted surface drainage, abundant enclosed depressions, and a well-developed system of underground drainage systems, which may include caves. The term “pseudokarst” is sometimes used to distinguish karst terrain formed on non-carbonate bedrock, such as sandstone.

To date, the forest has documentation that six caves have been nominated as significant caves (USDA Forest Service 2011k). One of the significant caves is the Lava River Cave, a recreational cave that is open to the public. The six significant caves variously meet the criteria for significance on the basis of their geologic/mineralogic/paleontologic values, biota, cultural values, hydrologic values, recreational, educational, or scientific values. Another seven caves are known and some have a resource evaluation report written for them. However, nomination forms are missing or absent and significant cave decisions are lacking for these caves. These seven caves are potentially significant.

To date, the forest has information on more than 50 caves across the area. Local cavers have also offered limited information to forest staff on karst and cave resources, and there are likely many more caves and cave resources known on the forest by these caving groups. Cave and karst resource surveys have started to be implemented for forest restoration, thinning, and prescribed burning projects including the Four-Forest Restoration EIS, the Clints Well Forest Restoration Project, and the Cragin Watershed Protection Project.

Forest wildlife biologists periodically monitor caves for bat use. White nose syndrome is a condition associated with the deaths of over a million bats in the United States and Canada since its discovery in the winter of 2006–2007 in New York State. A fungus, *Geomyces destructans*, is considered the primary causal agent of white nose syndrome. This fungus thrives in cold and humid conditions of caves and mines, which provide prime hibernating habitat for many bat species. It is suspected that the fungus is spreading through bat to bat, bat to cave, and/or human transmission into cave environments.

Bats exhibit white nose syndrome with a skin infection in the form of a white fungus on their muzzles and wings. However, bats affected with white nose syndrome do not always have the characteristic white fungal growth, but may display abnormal behavior in and outside of their hibernacula. It is hypothesized that bats affected by white nose syndrome arouse from hibernation more frequently, and/or for longer periods than normal, and are prematurely expending the fat reserves they rely on for winter survival. This expenditure of fat reserves is suspected of killing the bats when they are not able to feed as they emerge from the caves or mines in the winter (White Nose Syndrome Handbook, USDA Forest Service 2011l).

In 2010, *Geomyces destructans*, the fungus associated with white nose syndrome was found on the cave myotis bats in western Oklahoma, bringing the fungus within 250 miles of New Mexico. Both New Mexico and Arizona have a diverse bat fauna that includes 28 species, almost half of which hibernate to some degree during the winter. Therefore, it is important to take actions to reduce or prevent the spread of the disease, begin efforts to gather information regarding hibernacula and bat use, and begin surveillance efforts to identify any new areas containing white nose syndrome (USDA Forest Service 2011l).

In response, the Southwestern Region began working with Federal, State, and private partners during the summer of 2010 to begin addressing this critically important issue. Interagency white nose syndrome response and communications plans have been finalized for the State of New Mexico. Furthermore, the Southwestern Region is working with the State of Arizona to develop similar plans. Several forests within the Southwestern Region have begun increasing public awareness, collecting information on bat hibernacula, and initiating surveillance efforts for signs of the fungus or the associated disease (USDA Forest Service 2011l).

The White Nose Syndrome Handbook was prepared to assist forests in taking steps to address the disease. This handbook includes sections on decontamination protocols, emergency closure orders,

tribal considerations, abandoned mine lands considerations, surveillance, working with partners, communication tools, and National Wildlife Health Center submission guidelines.

The Forest Service has a memorandum of understanding with the Cave Research Foundation as of 2010 (USDA Forest Service 2011d). The Forest Service has had a long-standing relationship with this organization prior to the memorandum of understanding. The purpose of this memorandum of understanding is to foster cooperation to achieve more effective and efficient management and study of caves, and to establish a framework upon which the Cave Research Foundation and Forest Service may cooperatively conduct scientific research, mapping, and interpretive activities on forests.

The forest has worked in the past with various caving groups including the Central Arizona Grotto, Northern Arizona Grotto, Escabrosa Grotto, Cave Research Foundation, Bat Conservation International, Arizona Regional Association of the National Speleological Association, American Cave Conservation Association, and the Arizona State Game and Fish Department (USDA Forest Service 1992b – Forest Service, Decision Memo for Cave Management Goals and Standards/Guidelines, Coconino National Forest, December 22, 1992).

Review of the Coconino NF's cave records indicated that local cavers conduct their own use and impact monitoring of some caves. Sign-in sheets (cave registers) are present within some caves as well. When impacts to cave resources are noted, they have contacted the Forest Service and described the impacts. The impacts noted in the forest's files have been vegetation removal at cave entrances and sedimentation from nearby roads from bar or relief ditches and refuse within caves. Graffiti and trash at a well-known cave have also been removed by a cave group in cooperation with the forest.

Cliffs

The Coconino NF has many types of cliff resources. Examples include Jacks Canyon climbing area on the Mogollon Rim, the many canyons of streams draining the Mogollon Rim plateau such as East Clear Creek, Barbershop Canyon, West Clear Creek, Fossil Creek, the Mogollon Rim, and others. There are other canyon areas that contain cliffs in the Verde Valley and Sedona area including Oak Creek Canyon, Sycamore Canyon, and others. Most of these canyons are incised in sedimentary bedrock. Other cliff resources may be found in canyons cut through basalt lava flows such as Jacks Canyon in Upper Beaver Creek watershed and in volcanic depressions such as Stoneman Lake.

Cliffs provide important habitat for birds to roost and nest. In addition, there are several plant species that grow on cliffs and ledges. Some cliff areas also provide recreation opportunities for rock climbing.

Talus Slopes

Talus slopes[29] occur on all three ranger districts. Examples of talus slopes occur above the tree line on the San Francisco Peaks, on basaltic cinder cones in the eastern part of the San Francisco Volcanic Field, as sedimentary and basaltic talus in Oak Creek Canyon, as basaltic talus slopes below mesas such as at Chavez Pass, and on the flanks of Hackberry Mountain. Talus slopes can be devoid of vegetation or sparsely vegetated. Rare plants and animals are associated with talus deposits. Disturbance from recreation or management activities can destabilize the talus slopes and alter the habitat.

[29] Talus slope is the term used for specific reference to the surface of the talus. A talus slope is a steep, concave slope where rubble is deposited. It is also known as a debris slope.

Environmental Consequences

Common to All Alternatives

Caves and karst, talus and cliff resources are non-renewable biophysical features that provide important geological and hydrological functions and processes, and may contain important wildlife, cultural, paleontological resources as well as recreational, educational and scientific values. The loss or destruction of cave, karst, talus and cliff resources is an adverse condition because the biophysical, natural, cultural, scientific and educational values cannot be recovered. For all alternatives, land management activities, project planning, and project implementation require protection of cave and karst resources by adherence to the Federal Cave Resources Protection Act of 1988 and its implementing regulation 36 CFR 290, Cave Resources Management.

Alternative A

Management and protection of caves along with cliffs and talus slopes allows for the recognition, protection and conservation of unique and diverse geological features, and their associated hydrology, cultural resources, rare plants, and animals that occupy or occur in these habitats. Caves designated as being significant are protected under Federal law and regulation, but existing laws and regulations are broad based and are not prescriptive. For example, protection buffers are not mentioned in the law or implementing regulation. Thus, the forest plan can provide a more specific direction for the protection and management of caves and other biophysical resources.

Alternative A closely follows management direction provided in FSM 2356 and FSM 2880 with respect to policy, protection, conservation, research, and education, overall management of cave resources and evaluating impacts to caves during project planning. Alternative A is consistent with the general intent of the Federal Cave Resource Protection Act of 1988 (P.L. 100-691). The goals for cave management encourage partnerships with caving organizations, scientists, and outdoor recreationists.

Under alternative A, Amendment 9 added standards and guidelines to protect caves and caves resources as a result of the Federal Cave Resource Protection Act. In addition, the Decision Memo and a footnote cited in Amendment 9 references the “Coconino National Forest Cave Resource Management Guide” (USDA Forest Service 1992b). This management guide contains direction and instructions on cave inventory monitoring, general administration, cave ethics, cave management techniques, maintenance of confidential cave information and other topics. Alternative A is lacking desired conditions, standards, and guidelines for cliffs and talus slopes. Overall, this alternative’s standards and guidelines would have consequences of minimizing destruction or collapse of cave entrances, karst features or underground passageways from road construction, blasting or logging. The standards and guidelines would also minimize damage to speleothems, reduce sedimentation inputs into caves and karst features, and minimize pollution into streams that enter caves. It also would more closely manage changes to the vegetation and microclimate at cave entrances and around karst features that could occur from prescribed burning or activities associated with logging. Implementation of these standards and guidelines would be beneficial and protective of the cave and karst resources. The lack of additional plan direction for cliffs and talus slopes would result in those biophysical features being managed only to protect scenery and species habitat. Cliffs and talus slope features would then be vulnerable to destabilization from road or trail construction or OHV use, where scenery and species habitat are not concerns or where the talus slopes and cliffs are outside of wilderness. Where there are protected, endemic, or rare plant or animal species or habitat associated with talus scopes or cliffs other standards and guidelines in alternative A for these species and habitats would be utilized to protect or maintain the habitats and would as a consequence be protective of talus and cliff geologic features.

Plan direction in alternative A provides for inventory and evaluation of all known and newly discovered cave resources. The location and resources of significant caves are kept confidential to protect resources. Alternative A provides for district cave inventories, a district cave implementation schedule, cave monitoring and a cave management plan when needed. The alternative describes when cave management plans are prepared and that they undergo appropriate environmental review and public participation. Monitoring and use restrictions are also described and management techniques would be adjusted for caves based on results of monitoring. Significant caves are monitored to determine visitor impacts such as destruction or theft of speleothems, graffiti, and garbage and human waste dumping. Monitoring is also conducted to determine conditions of key resources such as wildlife and bat use. See 1987 Plan, page 51-1 for the above guidelines. The consequences of this plan direction would be that inventories would be conducted at the district or forest level so that all of the various caves and karst features would be identified. Once identified, caves could be nominated as significant according to the Federal Cave Resources Protection act of 1988. Once a cave is nominated as significant, it then is under a protected status and can be managed to preserve and protect the values for which it was nominated, which may include: biotic, cultural, geologic/mineralogic/paleontologic, hydrological, recreational, educational and scientific values. For example, a significant cave nominated for its recreational values can be open to public for visitation and this public use would be managed and monitored to limit damage to the cave resource and protect it from unwanted disturbance or environmental effects. Karst resources such as sinkholes that are not caves, for example, that are identified during inventories would be protected from equipment or ground disturbance so that the feature doesn't collapse and sediment doesn't fill in the sinkhole or close openings to the subsurface.

Plan direction under alternative A also states that caves used by bats are to be protected. Bat populations and use are to be monitored in consultation with State and Federal agencies. Protection measures may be implemented to protect bats and may include education, seasonal closures, and installing bat gates. Research in caves requires a permit, which is issued on a case-by-case basis with the district ranger. See 1987 Plan, Page 51-1 for the above guidelines. The consequence of this is that important wildlife species and their habitat associated with caves would be protected and monitored for adverse impacts from forest management activities or recreational uses and the presence of diseases such as white nose syndrome.

The risk of cave exploration and that risk-taking is part of the caving experience is acknowledged and accepted. Coordination with the county sheriff's department caving organizations to plan for cave search and rescue is also described in the alternative. See 1987 Plan, page 51-1 for the above guidelines. Interagency preparation and training for the possibility of cave search and rescue would have a positive benefit because agencies and caving organizations would have well-established communication, coordination, and rescue techniques and abilities to perform a needed rescue. Recent interagency training in cave entry, search and rescue has occurred on the Peaks Ranger District in 2017.

Various standards and guidelines in alternative A are described to ensure that ground-disturbance activities do not impact caves and cave resources. Surface land management decisions include consideration of potential impacts to all cave resources and karst features. Management activities would be evaluated for impacts to soil, hydrology, vegetation, air and water quality, or the potential to disturb to cave and karst features. Examples of impacts include: destabilization or collapse of cave passages or entrances, disturbance to wildlife or aquatic species and habitat, sedimentation, pollution, or changes to air flow and air quality. Maintenance of cave microclimate, hydrology, and entrance vegetation is a desired condition needed to protect long-term cave ecology. A minimum 300-foot radius around a cave entrance would be evaluated for effects as well as infeeder drainages

and the surface area on top of the cave. Cave exploration and techniques of exploration would be carefully considered so that major alterations to caves do not occur from exploration and survey. Use of special excavation techniques to open cave passages would be considered on a case-by-case basis and allowed activities would comply with appropriate laws and environmental reviews. See 1987 Plan, pages 51-1 and 51-2 for the above guidelines. The consequences of implementing these standards and guidelines are that cave and karst resources would be evaluated during project planning and protected during project implementation on a case by case or site-specific basis.

Drilling or seismic surveys would be carefully evaluated and appropriate buffers established so that known caves and karst features are not affected or damaged. Impacts from drilling or seismic surveys could include spelothem breakage or collapse of cave openings or passageways. Water drilling or other drilling operations are not allowed over known caves. This is so that sediments or pollutants are not introduced into caves and so that cave passages are not intercepted or opened in the drill hole. If previously undiscovered caves are encountered above the saturated groundwater zone, protection measures would be taken to prevent changes to the cave from flooding or from introduction of drilling and drilling materials. Significant caves with high resources values would be evaluated for mineral withdrawal. The outcome of withdrawing a significant cave from locatable mineral entry would be that the cave in its entirety would be protected from mining-related disturbance or destruction over a 20-year period. See 1987 Plan, page 51-2 for the above guidelines.

Wildlife habitat provided by caves would be conserved. This would be accomplished through cave and karst inventory and consideration of all surface land management activities and their potential impacts to wildlife associated with caves and karst features. This would be beneficial to all known and wildlife that utilize caves especially bats which may include protected species. See 1987 Plan, page 22 for the above guideline.

Water supplies that drain into, issue from, or are contained within caves would be protected from contamination. This would be accomplished through cave and karst inventory and consideration of all surface land management activities and their potential impacts to streams that enter or emerge from cave and karst systems. The establishment of cave protection buffers and streamside Aquatic Management Zones would be used to protect the hydrology and groundwater associated with cave and karst features. See 1987 Plan, page 22 for the above guideline.

Partnerships would be encouraged with caving organizations, scientists, and outdoor recreationists. Caves and cave resources would be managed to provide a range of recreational opportunities. Cave conservation would be promoted through interpretation and education. The outcomes of encouraging partnerships with a variety of groups would foster exchange of information about existing and new caves and karst features which would improve existing inventories and allow for future nomination of significant caves. Collaboration with scientists, caving organizations, and other agencies would increase the knowledge base of cave resources including wildlife habitat and use, geology, mineralogy, hydrology, paleontology and cultural resources associated with caves. The exchange of information and partnerships would also improve use of advanced technology to map, survey, and monitor and restore caves. Partnering with caving organizations would also foster cave and karst conservation education and promote environmentally ethical cave exploration and recreational use. See 1987 Plan, page 22 for the above guidelines.

The guidelines include protection of karst features. All management activity near or within a known cave area is examined for potential impacts to caves and karst features. Sediment from drilling access roads and drilling sites is not allowed to wash or be discharged into caves or karst features. See 1987 Plan, page 51-2 for where karst is mentioned. Management of activity-generated sediment and water from drilling sites and access roads is critical to streams and water quality resources as

well as cave and karst features. Sediment, rock chips and pollutants from drilling fluids would be an adverse effect to caves and karst features because it would pollute groundwater and surface water resources and sediment from drilling could introduce contaminants and could fill sinkholes and cave passages. Sedimentation from management activities such as logging and pollution from spills is considered in project planning and design features and BMPs are specified in planning documentation and are implemented protect water quality and riparian resources.

In summary, the 1987 Plan as amended, or alternative A, closely follows management direction provided in FSM 2356 and FSM 2880 with respect to policy, protection, conservation, research and education, overall management of cave resources and evaluating impacts to caves during project planning. Alternative A is consistent with the Federal Cave Resource Protection Act of 1988, which is protective of significant caves and the values for which they are nominated. Alternative A has very specific guidelines for buffering cave and karst features to protect them from ground-disturbing activities and for protection of the ecology, natural functions and processes, as well as animals and plants and protected species that use or live in caves. The goals for cave management encourage partnerships with caving organizations, scientists, and outdoor recreationists. Alternative A protects the location information of significant caves by describing that the location and resources of caves are kept confidential when the need is to protect archaeological, wildlife habitat, cave biota, geological features, and paleontological deposits. Alternative A also has specific language providing for inventory and evaluation of all known and newly discovered cave resources, which is different than the other alternatives that do not address inventory of cave and karst resources. Because the forest has many more karst features than caves and significant caves, inventory of these features across the forest is very important in order to manage them and to provide for their protection during implementation of management activities. Overall, the consequences of implementing this alternative's standards and guidelines to minimize impacts to caves and karst features would be beneficial and protective of cave and karst resources.

Management of the forest's cliffs and talus slopes is not addressed in alternative A except with respect to maintenance of the scenic views of the red rock cliffs of the Sedona area, Management Area 22. See 1987 Plan, pages 206-35, 206-43, and 206-46. There are no desired conditions, standards, guidelines or management approaches for talus slopes and cliffs specific to their occurrence and current conditions of these biophysical resources on the Coconino NF. Because the management of the stability and integrity of talus slopes and cliffs and their ecosystems is not addressed, there would be no direction for management of these features and the habitats they provide. The management of cliffs and talus resources would be mainly dictated by following existing law, regulation, and Forest Service policy related to other resources such as wildlife or botanical resources. For example, talus slopes would be managed to protect rare plants where they occur, or cliffs would be managed to protect peregrine eyries where they occur. This lack of management direction specific to talus slopes and cliffs would likely result in more localized disturbance to cliffs and talus slopes from recreation or management activities such as road or trail construction than alternatives B (modified), C, and D.

Another outcome of the lack of direction for talus slopes and cliffs in alternative A is that there may be inconsistent approaches to talus and cliff management across the forest. As a result the potential to overlook or not fully protect these resources could occur during project planning and implementation. Another consequence is that without desired condition statements, standards, guidelines or management approaches for talus slopes there are no indicators to evaluate whether a resource or an aspect of a resource in not fully functioning at a desired condition or is not meeting a guideline. The gap between the existing condition of talus slopes or cliffs (e.g., OHV use is destabilizing a talus slope or rock climbing on a cliff is disturbing a rare plant population) and the

desired condition can lead to implementing positive management actions to remedy the effects of a disturbance and maintaining or improving the conditions of talus slopes or cliffs.

Alternative B (modified)

The revised land management plan developed for alternative B (modified) contains desired conditions, one standard, several guidelines and management approaches for caves, karst, cliffs and talus slopes in the Biophysical Features section of the plan under Geological Features.

The general description section of Geological Features describes general definitions of caves, cave resources, karst, cliffs, and talus slopes and their important physical, ecological, and cultural attributes. Alternative A does not provide a description of the resources or definitions of these resources. The plan goes into detail about the description of caves, karst and pseudokarst terrain present on the forest and associated resources found with the karst terrain. The outcome of having a concise description of cave, karst, talus slopes and cliff resources as well as providing key definitions for attributes of these resources is that their importance and diversity is emphasized and highlighted allowing for better management of these varied resources.

The desired conditions for geological features provide a framework to be used across the forest for protecting the important features of caves, karst, cliffs and talus slopes in alternative B (modified) that is not present in alternative A. Seven distinct desired condition statements are found in alternative B (modified) that relate to protecting these features from adverse effects from disturbance, maintaining their natural functions and processes, safeguarding habitat for animals and plants that use or live in or on these resources including protected species, protection of significant caves, and maintaining the ecology and microclimate of properly functioning biophysical and geological features.

Biophysical features are generally left undisturbed by human activities. The cultural, archaeological, geological, hydrological, paleontological, biological, and aesthetic resources associated with caves, karst, cliffs and talus slopes are maintained. See FW-BioPhys-Geo-DC-1.Karst landscapes and cave formations continue to develop or erode under natural conditions. Water and the hydrological system of the cave is not altered and contains normally fluctuating background levels of water, sediment, organic matter and dissolved minerals and is not polluted. See FW-BioPhys-Geo-DC-2. These two desired conditions relating to disturbance, resource values, and protection from pollution, sedimentation and maintenance of natural functions and processes are consistent with protection of significant caves under the Federal Cave Protection Act of 1988 and would protect the structure, functions, processes and ecology for karst features, cliffs and talus slopes.

Additional desired condition statements emphasize maintenance and protection of habitat for wildlife in caves (FW-BioPhys-Geo-DC-3) and natural development of the overall cave ecosystem (FW-BioPhys-Geo-DC-2). Conformance to these desired conditions would protect wildlife that use caves such as bats, invertebrates and other animals and limit disturbance to the overall cave ecology and speleothems, and would foster the natural functions and processes of the overall cave and karst system which can be altered by human activities and forest management activities.

Habitat for wildlife species including bats is maintained and protected in caves and karst features. Caves maintain the humidity, temperature and disturbance levels consistent with historic conditions. Caves known to be important for endemic, rare, federally listed, Southwestern Region sensitive species or roosting bats are to be kept intact to provide habitat for these species and disease is within natural levels. See FW-BioPhys-Geo-DC-3. Likewise for cliffs and talus slopes, the desired conditions are to maintain and protect habitat for federally listed, sensitive, and rare wildlife and plant species associated with the special niche habitat (FW-BioPhys-Geo-DC-6 and 7). These desired

condition statements focus on habitat for various protected animals and plants that utilize caves, karst features, talus slopes and cliffs which have unusual and special environmental conditions. Conformance with these along with the other desired conditions would have a consequence of allowing the natural functions and processes associated with these resources to occur minimally disturbed or affected by human activities or forest management activities and so would benefit and minimize adverse disturbances or conditions for protected or rare wildlife and plants.

The structure, composition and function of the vegetation (ecological response units) around caves, karst and pseudokarst features is protected and maintained to provide for the microclimate and ecology that has evolved over time. See FW-BioPhys-Geo-DC-4. The vegetation surrounding cave and karst features is important to preserve the shading, temperature and air flow into openings. Vegetation, including riparian plants where water flows into or out of karst openings, is critical to buffer and trap sediment and debris that could fill sinkholes and cave passages. Conformance with this desired condition would guide planning efforts that involve vegetation management or prescribed fire in cave, karst or pseudokarst areas.

Significant caves have excellent examples of the values for which they were designated, with little evidence of human activity or disturbance. Visitor access and use occurs at levels that maintain the values of the significant cave. See FW-BioPhys-Geo-DC-5. This desired condition statement is consistent with protection of significant caves under the Federal Cave Protection Act of 1988 and is an important indicator of how the forest is complying with the law for significant caves. As an example, a significant cave with a bat maternity colony would be gated and closed to visitor use during the time the colony is roosting in the cave.

With respect to cliffs and talus slopes, the desired condition statements emphasize specialized habitat, especially where they provide important habitat for birds, plants, or other species of concern. Cliffs provide specialized habitats for a variety of species including nesting and feeding habitats for birds of prey and roosting habitat for bats. They provide escape, bedding, and lambing cover for bighorn sheep. They provide habitat for rare plants such as cliff fleabane, and Senator Mine alumroot. See FW-BioPhys-Geo-DC-6.Talus slopes provide specialized habitats for lichens, plants, invertebrates, and vertebrates, including rare species such as the San Francisco Peaks ragwort. They maintain natural levels of moisture and are free from excessive sedimentation. See FW-BioPhys-Geo-DC-7. Utilizing these desired conditions as would provide an important check for whether plant or animal habitats associated with cliffs or talus slopes could be affected during planning and implementation of management activities or associated with the varied ongoing recreational activities that occur on the forest such as mountaineering, rock climbing and rappelling. There is nothing that speaks to desired conditions for habitat provided by talus slopes and cliffs in alternative A. One standard is described. It is to manage significant caves to preserve and perpetuate the criteria for which they were nominated and designated. See FW-BioPhys-Geo-S-1. The outcome of implementing this standard is that the six significant caves and seven potentially significant caves on the forest would be managed according to the Federal Cave Resources Protection Act of 1988 and its implementing regulation 36CFR290, Cave Resources Management. Future caves or karst features that are found from inventories to be significant would also be managed under this standard. Caves are nominated to be significant because of their biotic, cultural, geologic/mineralogic/paleontologic, hydrological, recreational, educational and scientific values. The caves and their important attributes would be fostered and protected by site-specific management which could include a cave management prescription, cave inventory and mapping and monitoring.

Various guidelines are described in alternative B (modified).

Projects should be designed and forest uses should be managed to maintain the integrity and function of caves, karst, cliffs and talus and mitigation measures should be designed to mimic pre-disturbance conditions and functions. See FW-BioPhys-Geo-G-1. The consequences of this guideline is that cave, karst, talus and cliff resources will be considered during all project planning. Design features or BMPs would be developed for project implementation that either would have no effects to these resources or no adverse effects and that any disturbance would be restored or rehabilitated back to pre-disturbance conditions and functions. Adherence to this guideline would be protective for maintaining natural functions and processes of these features, their ecology and habitat for plants and animals, maintain the stability of slopes, rock cliffs and subsurface passages, and limit potential sources of sediment and pollution from entering cave and karst systems.

Projects and activities should be designed to prevent siltation into sinkholes and cave entrances, collapse of cave passageways and alteration of the chemical, physical and biological conditions of the cave resource. This is accomplished through designating protection buffers for known caves, karst features, sinkholes, or pseudokarst features such lava tubes. The plan states that a radius of 300 feet should be used for restriction on activities that can alter the cave's resources, functions and associated features. Site-specific adjustments to the buffers can be made based on topography, drainage, soil type, and expected impacts of any proposed activity. See FW-BioPhys-Geo-G-2. The consequences of this guideline are that it clearly explains the need and importance for protection buffers and that they would be developed for caves and karst features on a site-specific basis or would use the 300-foot radius around a cave or karst feature. This guideline would minimize adverse effects of disturbance from vegetation management and other recreational or forest management activities on cave and karst features.

Water well or other drilling, blasting, and seismic exploration should not impact or damage biophysical features. See FW-BioPhys-Geo-G-3 and G-4. This guideline ensures that during planning and implementation of any drilling, blasting or geophysical exploration activities, cave, karst, talus and cliff resources are considered and that design features, buffers or other migration measures would be adopted to minimize adverse effects.

When there is a need to close a cave entrance to public entry, Bat Conservation International recommendations should be followed to protect bats and other wildlife species that utilize the cave. See FW-BioPhys-Geo-G-5. Bat Conservation International has a long record of experience and a proven scientific basis for designing appropriate gates that are friendly to bats while closing the cave to public entry. Following this guideline would ensure that closure methods are protective for bats that roost or utilize cave systems.

Caves and abandoned mines that are used by bats should be managed to prevent disturbance to the bats that use these features and to prevent introduction and spread of white-nose syndrome or other diseases. See-FW-BioPhys-Geo-G-6. The forest has no known abandoned mine shafts or adits. White-nose syndrome is not known in Arizona as of 2017. Caves that contain endemic species should be managed to protect those species. See FW-BioPhys-Geo-G-7. Monitoring caves is critical for implementation of this guideline and would be used to document bat use in caves and/or the presence of other specialized plants or animals. Monitoring caves for bat use would determine whether white-nose syndrome or other diseases are present. Forest management under this guideline would be protective of cave resources.

Aquatic management zones or best management practices should be applied to stream courses to protect and maintain the chemical, physical and biological conditions of connected or downstream caves, karst features and lava tubes. See FW-BioPhys-Geo-G-8. This guideline works in concert with FW-BioPhys-Geo-G-2 so that caves and karst resources would be protected from disturbance,

sedimentation or pollution and that appropriate buffers around these features, best management practices and aquatic management zones are developed during project planning used during implementation to protect streamcourses that are connected to cave and karst systems. This guideline would maintain the integrity and natural functions and processes of cave and karst resources.

Various management approaches (eight) are proposed.

In summary, alternative B (modified) provides desired conditions for karst, talus slopes, and cliffs in addition to caves, which is distinct from alternative A, which does not address karst, cliffs, and talus slopes as important biophysical and geological features and habitats. Desired conditions statements are not apparent in alternative A. All of the measures are expressed as guidelines with no standards or desired condition statements. Desired conditions statements in alternative B (modified) address acceptable levels of human disturbance, resource protection, natural processes of formation, maintaining and protecting from disturbance intact habitats for wildlife and plant species, maintenance of the important vegetation habitat surrounding caves and karst, and protecting the habitat and quality of special biophysical features of cliffs and talus slopes. Desired condition statements are useful to forest managers because they provide an indicator to evaluate whether a resource or an aspect of a resource is not fully functioning at a desired condition. The gap between the existing condition of a significant cave, and the desired condition, for example, visitor use is damaging cave speleothems, can lead to implementing management actions to remedy the visitor issue and maintain the values of the significant cave. Specific desired conditions for caves, karst, cliffs and talus slopes in alternative B (modified) would be more protective of caves, karst, cliffs, and talus slopes than alternative A, which has none, and that variance from desired conditions would be more obvious to forest managers.

Alternative B (modified) has one standard relating to designated and nominated significant caves while alternative A has no standards. However, there are several guidelines in alternative A that specifically relate to the management of significant caves that follow the Federal Cave Resource Protection Act of 1988. Both alternatives would be equally protective because the forest would fully comply with the Federal Cave Protection Act and implementing regulations along with Forest Service Handbook and policy relating to caves and karst resources.

The first two guidelines in alternative B (modified) are very similar to the first three guidelines found in alternative A. Slight differences are found in the language of alternative B (modified), which mentions mitigations should be designed to mimic pre-disturbance conditions and functions, and sinkholes are to be protected in addition to caves. Both alternatives have a protection buffer of 300 feet around caves and karst features that would be evaluated for impacts from project activities. Alternative B (modified) allows for site-specific adjustments to protection buffers depending on the activity and importance of the cave or karst feature. Alternative A specifically mentions that caves and karst features are not to be used for slash, waste rock, or fill disposal. This is equivalent to alternative B (modified), which doesn't mention disposal in caves or karst features, but emphasizes that the integrity and function of caves and karst features are to be maintained and the cave resources unaltered. Alternative B includes karst and pseudokarst features in all of the discussions related to management and protection. The forest contains many more karst features than caves or significant caves and so this would be more protective than alternative A to maintain the integrity, stability, process, function, and surface and groundwater quality of the karst ecosystem.

Guidelines 3 and 4 in alternative B (modified) are similar to guidelines 4, 6, and 7 of alternative A, which address alterations to caves, drilling, blasting, and seismic surveys requiring explosives. Both alternatives only allow excavation to explore a cave or seismic surveys and blasting in the vicinity of a cave if this disturbance would not impact and will maintain the integrity of a known cave and its

resources. Both alternatives would be equally protective of cave and karst features when these types of activities are considered in planning and subsequent implementation.

Preventing the introduction and spread of diseases into caves is a guideline in alternative B (modified), whereas disease prevention is not mentioned in alternative A. Constructing wildlife-friendly gates to close caves to public entry is a guideline in alternative B (modified), but is not in alternative A. Both alternatives provide for protection of bat colonies that use caves including seasonal closures and gating to minimize disturbance to species using the cave. Alternative B (modified) provides for protection of endemic cave species, while alternative A does not. Alternative B (modified) provides protection for streamcourses that enter or become connected to caves, karst features, or lava tubes though use of aquatic management zones and best management practices. Alternative A provides for protection of infeeder drainages that lead into caves or open karst features (swallows and sinking streams), but doesn't say how to provide protection whereas alternative B (modified) specifically mentions aquatic management zones and best management practices. Alternative B (modified) would better protect cave and karst resources and the wildlife and other species that utilize these resources than alternative A because it has more well-defined guidelines.

Management approaches in alternative B (modified) emphasize coordination, cooperation, and partnerships with other agencies, cavers, and scientists to protect, monitor, and develop information about caves, karst, cliffs, and talus slopes, and the key resources associated with them. This emphasis on cooperation and education is more extensive than alternative A. Assessment of impacts to caves, karst, cliffs, and talus slopes and the use of cave protection buffer zones are more clearly described in alternative B (modified) than in alternative A. The consequences of this are that alternative B (modified) would be better than alternative A at fostering positive partnerships that would work together with the forest to benefit the management, protection and scientific study and education relating to caves, karst resources, talus and cliffs.

Various recreational activities including rock climbing, and caving, as well as management activities including road construction, logging and mining activities, can collapse cave passages, damage speleothems, introduce graffiti, introduce sediment and pollutants into caves and groundwater, and destabilize talus slopes and cliffs. These threats could alter habitat, which may prevent plant establishment, destroy plants, or affect the survival of talus snails. Roosts on cliffs and in caves may become unsuitable for bats and nesting habitat can be disturbed, modified or removed by noise, unethical recreational use and damage from rock bolting. Recreational caving that does not follow standard cave exploration practices can modify surface features, temperature, and humidity levels, which in turn modifies the environment for plants and animals. Though the guidelines are somewhat similar between the two alternatives, alternative B (modified) has more extensive and better protection measures for caves, karst, pseudokarst ,and talus slopes and cliffs than alternative A. Further, the desired conditions for caves, karst, cliffs, and talus slopes in alternative B (modified) are an improvement over alternative A, and will allow forest managers to describe any gaps between the existing and desired conditions and develop management actions to better meet desired conditions. Alternative B (modified) also has many management approaches that go further than the guidelines in alternative A to better manage and monitor significant caves, other karst resources, cliffs, and talus slope areas to address problems with recreational impacts and to foster education and conservation of these resources. Like alternative A, until an updated forestwide cave and karst management strategy or guidebook is prepared, forest managers will need to be well versed in FSM direction in 2880 and 2356, and in the Federal Cave Protection Act and in the CFR 36 Part 290 to implement the full extent of the laws and regulations relating to caves.

Alternative C

As it relates to caves, karst, cliffs, and talus slope management, alternative C uses the same plan components as those discussed under alternative B (modified). Accordingly, the consequences of alternative C are the same as for alternative B (modified) for the biophysical features of caves, karst, cliffs, and talus slopes.

Alternative D

As it relates to caves, karst, cliffs, and talus slope management, alternative D uses the same plan components as those discussed under alternative B (modified). Accordingly, the consequences of alternative D are the same as for alternative B (modified) for the biophysical features of caves, karst, cliffs and talus slopes.

Cumulative Effects

The timeframe and boundary of this analysis is for the next 10 to 15 years and includes NFS lands within the Coconino NF boundary and local communities, national monuments, and other national forests adjacent to the forest boundary. The national forests considered include the Kaibab, Prescott, Apache-Sitgreaves, and Tonto National Forests. Past, present, and future actions conducted on the Coconino NF that cumulatively contribute to the impacts to biophysical resources and geological features of caves, karst, talus slopes and cliffs include site-specific ground-disturbing activities associated with forestry, logging, fire, land use and development, and recreational use and development. Examples of land use and development include construction of facilities and infrastructure such as offices, powerlines, and roads. Examples of recreational use and development include construction of visitor information facilities, trails, roads, parking and use areas.

Ground-disturbing activities of the types listed above on private and public lands beyond Coconino NF boundaries can have the same effects of damaging or altering the natural functions processes and ecology of cave and karst systems, talus slopes, and cliffs. As ground-disturbing, developmental or recreational activities increase (such as increases in housing, road building and associated infrastructure in the areas adjacent to the forest from regional population growth), the potential to affect cave and karst resources, talus slopes and cliffs will continue. Effects to cave and karst features that may occur include: sinkhole or cave collapse, damage to speleothems or cave walls from vandalism and graffiti, garbage and human waste dumping, and sedimentation and pollution (e.g., from septic systems) into the karst ecosystem on the ground surface and subsurface. Effects to talus slopes and cliffs that may occur include destabilization to talus slopes from undercutting by trails and roads, rock fall from cliffs from fire or from bolting from rock climbing. Effects such as disturbance, trampling or loss of habitat may also occur to animals and plants that use or are adapted to the environments and ecology of caves, karst features, talus slopes, and cliffs.

Caves, karst features, cliffs, and talus slopes are present on other nearby national monuments such as Montezuma Well, Walnut Canyon and Sunset Crater Volcano National Monuments, and are protected under management plans of those national monuments. Protection of significant caves occurs on all federally managed lands (including Tribal lands) under the Federal Cave Resources Protection Act of 1988 and associated implementing regulations for the Forest Service and the National Parks. Both the National Park Service and the Forest Service have internal policy and guidance to develop and foster communications, cooperation, and volunteerism with interested publics, Federal agencies, states, and local governments.

The Apache-Sitgreaves, Kaibab, and Prescott National Forests have recently completed their revised land management plans. All of the revised plans contain language to protect bats that use caves to minimize disturbance to them and to limit the introduction or spread of disease (e.g., white-nose

syndrome). The Apache-Sitgreaves and Kaibab National Forests have desired conditions, guidelines and management approaches to protect caves, karst, cliffs talus slopes, and rocky features from damage while maintaining and providing the appropriate recreational opportunities they afford and retaining their distinctive ecological functions and habitat for species that use or live on them. The Tonto National Forest is preparing their revised forest plan, but their current forest plan provides for management, protection, research, recreation, and education relating to their cave resources. The cumulative effect of alternatives A, B (modified), C, and D for the Coconino NF would be both positive and beneficial for geological features when considered with implementation of cave, karst, cliffs, and rocky features resource management direction of the four adjacent national forests.

All of the alternatives (A, B (modified), C, and D) have some component that fosters interagency cooperation and exchange of information across agencies and with interested publics and stakeholders. Alternative B (modified) along with alternatives C and D, however, has several management approaches that encourage partnerships and collaboration with a broader range of agencies, organizations such as cave grottos, and national groups such as the Cave Research Foundation, Bat Conservation International, Arizona Regional Association of the National Speleological Association and American Cave Conservation Association. This cooperation would provide for increased opportunities to develop partnerships with the scientific community, researchers, and conservationists interested in caves and karst resources and would expand our collective knowledge about these features and improve our management to protect them. The partnerships and collaboration would benefit the forest through working together on bat monitoring; cave monitoring for use and resource damage or other problems; organizing workshops on cave survey, inventory and research to expand our knowledge; and working on cave restoration interpretation and education. Alternative A has minimal guidance and no management approaches for partnerships and collaboration except a statement to encourage partnerships with caving organizations, scientists, and outdoor recreationists and to partner with Arizona Game and Fish Department to monitor bats. Though talus slopes and cliffs are not protected by Federal law, the various plants and animals that use these habitats or are endemic to them may be protected or have management guidance in respective management plans. Cooperation between land management agencies would be a positive benefit to the management of these features and foster increased stewardship of these resources for all of their environmental and ecological values.

The cumulative effects of alternative B (modified), C, and D would, overall, be more positive and beneficial to the geological features of caves, karst, cliffs, and talus slopes than alternative A because though the guidelines for mitigating ground disturbance and other management activities are similar between the three alternatives, alternative B (modified) and C and D have greater strength because of the desired condition statements, and a wider range of management approaches for partnerships, cave management plans and guides, collaboration with other groups, management of significant caves and protection of location information, bat monitoring, and educating the public about the ecology and value of these geological features. Alternatives B (modified), C, and D would better protect the geological features on the forest and, in turn, through partnerships and collaboration, would foster increased awareness and resource protection across the adjacent public lands and communities.

Paleontological Resources

Background

Paleontological resources are fossilized remains, traces, or imprints of organisms, preserved in or on the Earth’s crust that provide information about the history of life on Earth, excluding any materials associated with archaeological resources or any cultural item.

The Paleontological Resource Preservation Act of 2009 (P.L. 111-011) (PRPA) regulates and protects all fossils including invertebrate fossils on the Coconino. The law and regulations provide for research activities and collection of paleontological resources under permit, permit reporting requirements and control of locality information, curation and preservation of resources, and prohibited acts and criminal penalties for unauthorized removal, damage or sale of paleontological resources.

The forest currently manages paleontological resources under the PRPA and its implementing regulations, 36 CFR 214, 215, and 291.

Affected Environment

The forest has many paleontological resources, most of which are only well known by paleontologists associated with universities, the Museum of Northern Arizona, the U.S. Geological Survey, and the Arizona State Geological Survey.

Paleontological resources on the forest include:

- Invertebrate fauna such as brachiopods, corals, sponges, trilobites, mollusks, stromatolites, forams, radiolarians, and conodonts.
- Plants such as ferns, horsetails, conifers, cycads, and palm fronds.
- Trace fossils such as arthropods, spiders, ant lions, and other insects.
- Vertebrate fauna such as fish, shark teeth, reptiles, amphibians, horses, camels, gomphotheres, mastodons, rodents, and tracks and trackways of these fauna.

The Forest Service uses a tool called the “Probable Fossil Yield Classification” as a planning tool wherein geological units, usually at the formation or member level, are classified according to the probability of yielding paleontological resources that are of concern to land managers. Existing statutes and policies regulate the collection and disposition of vertebrate fossils, and guide the collection of invertebrate fossils. Vertebrate fossils are protected by law and regulation; thus, this classification is based largely on how likely a geologic unit is to produce vertebrate fossils.

Most of the forest’s geological formations are associated with Class 3 (fossiliferous sedimentary geologic units whose fossil content varies in significance, abundance, and predictable occurrence). However, there are examples of Class 5 geological formations: highly fossiliferous geologic units that regularly and predictably produce vertebrate fossils and/or scientifically significant non-vertebrate (plant and invertebrate) fossils. These Class 5 geological units are at risk of natural degradation and/or human-caused adverse impacts) and may contain vertebrate tracks and trackways that are poorly covered and have significant value because of the preservation status and the diversity of fossil tracks at the locality that could be easily damaged or vandalized.

To date, the forest has documentation of several reports pertaining to fossil resources. Fossil tracks and trackways are known from the Verde Formation sedimentary rocks near Camp Verde, Cornville, Cottonwood, and Montezuma Well that include tracks of camels, ancestors of the saber-toothed cat, sloths, and the gomphothere (Pliocene elephant) (National Park Service 2006a, 2006b). Other camel tracks are in the Verde Formation along the Verde River near Beasley Flat (Prescott NF) and in the Verde Formation within the proposed Cottonwood Basin Botanical and Geological Area, and outside of the geologic area where the fumeroles are located. These tracks require documentation as a paleontological resource. The geological formations containing the fumeroles are much older than the Verde Formation and likely would not preserve tracks and trackways.

The forest has several evaluated paleontological resource sites determined to be "significant." In 2004, a pipeline construction project along Highway 179 near Sedona, unearthed slabs of rock containing large examples of Permian plant fossils associated with the Hermit Formation (Gillette 2004; Iverson, December 27, 2004 email). Due to their size, these fossil-bearing slabs remain in place. During construction, they were covered with other rock and soil for in situ protection. In 2005, the Museum of Northern Arizona recorded and collected paleontological resources consisting of shark teeth, invertebrates, and nautiloids from the Kaibab Formation along Lake Mary Road (Gore 2005). In 2013, paleontology resources of two trackways were recorded and investigated by Gillette (2013) in the Hermit Formation near Sedona. The trackways are of vertebrate tetrapods, most likely of synapsid reptiles, which are considered "early mammal-like" reptiles of Permian age.

Operating under the PRPA, the authorized officer (the Forest Supervisor) considers "the rarity, uniqueness, or distribution of invertebrate fossils or plants when determining whether a fossil is common or uncommon and may be casually collected." The final rule allows for prohibiting casual collecting on National Forest System lands that are closed to casual collecting under other statutes, executive orders, regulations, or land use plans.

The forest currently authorizes the collection of common invertebrate and plant paleontological resources without a permit, but sale is illegal. There are no closures to casual fossil collecting on the forest, and that practice has not been determined to be an issue at this time. Special-use permits are required for paleontological research and collection on the forest.

Environmental Consequences

Common to All Alternatives

Paleontological resources are non-renewable scientific, educational, and recreational resources. The loss or destruction of paleontological resources is adverse and significant without recovery of the scientific and educational values of the resource. There is a direct association between potential impacts and the potential sensitivity of the sedimentary rocks for paleontological materials. The probability of impact in low sensitivity areas is remote because those sedimentary rocks are not known to contain vertebrate fossil remains. The highest probabilities for impacts are to those sedimentary rocks known to contain fossil remains.

All alternatives, all future project planning, and project implementation requires adherence to the Paleontological Resources Preservation Act (PL 111-011, March 30, 2009) and final implementation regulations for the protection of resources Paleontological Resources Preservation, 36 CFR Parts 214, 216, and 291, Federal Register Vol 80, No 74, April 17, 2015)

Alternative A

Alternative A does not consider the need for paleontological resource management, guided by the PRPA or its implementing regulations, 36 CFR 214, 216, and 291. Under alternative A, there are no desired conditions, standards, guidelines, or management approaches for paleontological resources developed with the known current conditions on the Coconino NF; therefore, paleontological resources would only be managed as directed by existing law, regulation, Forest Service policy, and guidance. Project-by-project consideration of areas with high potential for adverse effects to paleontological resources during project planning and implementation is the current management approach. Alternative A considers the effects on sedimentary rocks across sediments with a high potential to yield paleontological materials on a project-by-project basis, without consideration of a trend to a consistent desired condition. Anticipated effects on moderate and low fossil-bearing sedimentary rocks are the same. Finally, considerations of adverse effects occur on a project-by-project basis.

Under alternative A, there are no desired conditions, standards, guidelines, or management approaches for paleontological resources. The absence of desired conditions, guidelines and management approaches for this resource may result in inconsistent forest management for paleontological resources over time and throughout the forest. As a result, the potential to overlook or not fully protect paleontological resource values at risk can occur during project planning and implementation. Line officers would be unaware of the variety of paleontological resources on the forest or the needs for management and protection of these resources. Relationships with research paleontologists and public awareness, interpretation, and education about paleontological resources would not be fostered if the forest plan is silent about these important resources. Desired condition statements and guidelines are useful for forest managers because they provide an indicator to evaluate whether a resource or an aspect of a resource is not fully functioning at a desired condition or is not meeting a guideline statement. The gap between the existing condition of a paleontological resource, and the desired condition (e.g., visitor use is damaging fossil trackways) can lead to implementing management actions to remedy the visitor issue and maintain the values of the paleontological resource.

Under alternative A, paleontological site protection, enhancement and interpretation would remain at current levels, generally occurring when a fossil find has occurred on the forest. The effects of damaging paleontological resources without recovery of values would result in the loss of site-specific knowledge. The loss of paleontological resources in areas that are presently known and considered low-probability will skew current models about the potential for presence of paleontological resources, thereby indirectly affecting future identification.

Alternative A does not specifically address paleontological resources and does not provide any management approaches for their enhancement and interpretation. While this approach is in keeping with the PRPA and its implementing regulations, it does not provide consistent criteria for the conditions of paleontological resources on the forest. The effect of inconsistent desired conditions can reduce the ability of the forest to protect the scientific and educational values of these resources. The final rules for the PRPA allow for the Chief of the Forest Service to establish a program to increase public awareness about the significance of paleontological resources on National Forest System lands. The forest does not emphasize promotion of paleontological educational or interpretative programs.

Alternative B (modified)

Overall, the implementation of alternative B (modified) on paleontological resources would be more beneficial than alternative A, and somewhat similar to alternatives C and D.

Under alternative B (modified), there would be a reduction of potential adverse effects to paleontological resources, in terms of the extent of paleontologically sensitive sedimentary formations and fossils within sedimentary rocks that may be affected, because of forest-specific desired conditions. The desired conditions in alternative B (modified) are uniform across the forest and present a forest-specific framework to define adverse effects, than the general conditions outlined in the PRPA and its implementing regulations. The desired condition for vertebrate fossils (commonly bones, teeth, tracks and trackways) and uncommon invertebrate fossils is that they remain protected on the forest unless collected under permit (FW-BioPhys-Paleo-DC-1). The desired condition for paleontological resources collected under permit is preservation in a repository along with copies of associated records so that they may be available for scientific research and public education (FW-BioPhys-Paleo-DC-1).

Adverse effects include loss through destruction from vandalism, looting, and illegal collection. Guidelines in alternative B (modified) are in place to address these issues. One guideline (FW-

BioPhys-Paleo-G-1) focuses on protecting paleontological resources in known locations from disturbance to conserve scientific, interpretative, and legacy values (associated with geological units that likely contain probable fossil yield classes 3, 4, and 5). Another guideline (FW-BioPhys-Paleo-G-2) provides the option of closing certain areas or requiring a permit if greater protection is needed for paleontological resources from casual collecting.

All of these management approaches are consistent with current law and Forest Service policy and would be beneficial to the paleontological resources on the forest. Some of the management approaches exceed law and regulation and would be more protective and conserve fossil resources better than alternative A.

Alternative B (modified) proposes a variety of enhanced management approaches:

- interagency collaboration and coordination, particularly with the scientific community;
- educational programs, interpretative presentations, and publications;
- closure to casual fossil collecting, or requiring a permit for such collecting in areas including, but not limited to wilderness, botanical, geological or research natural areas and caves and karst;
- promoting use of conservation and preservation measures;
- stabilizing new or known fossil-bearing sedimentary rocks;
- monitoring fossil-bearing sedimentary rocks;
- enhanced records management for internal and external use;
- survey for the presence of resources during the project planning process or as a part of a broader paleontological survey program, and
- using in situ preservation by directly protecting paleontological resources from direct destruction during project implementation or developing data collection strategies to preserve relevant information of value.

Outcomes, or effects, of these management approaches provide greater protection of paleontological resources than under alternative A and have positive effects in protecting their scientific and educational values.

Enhancing management beyond the current approach (simply dictated by legal requirements of PRPA and its implementing regulations described in alternative A) have significant beneficial effects directly to paleontological resources. Coordination of research, closure to collection, active conservation and protection, stabilization, monitoring, and enhanced records management preserves the scientific and educational values of the resource (e.g., protecting the physical integrity, stability of the values contributing to significance). This approach also identifies potential threats such as erosion, damage, or vandalism—allowing the forest to address issues before they become problems. The education and interpretive component of alternative B (modified) increases public awareness, with the expectation of increased support for preservation and/or protection. In this way, paleontological resources are available for current and future generations to enjoy as part of America’s national heritage; emphasizes working with external partners to: (1) promote educational and/or interpretive opportunities, (2) foster stewardship by the public, and (3) cooperatively monitor known resource locations.

The desired conditions, guidelines and management approaches follow the intent of the PRPA and final rule or provide increased protection and better management of paleontological resources.

Alternative B (modified) recommends four new special areas: West Clear Creek Research Natural Area (RNA) (1,007 acres), Rocky Gulch RNA (926 acres), an addition to San Francisco Peaks RNA (141 acres), and the Cottonwood Basin Botanical and Geological Area (763 acres). Alternative B (modified) also recommends three wilderness areas: Strawberry Crater (6,579 acres), Davey's (1,739 acres) and Abineau (415 acres).

There are effects on sedimentary rock formations with a high potential to yield paleontological materials with the proposal of the West Clear Creek Research Natural Area and the Cottonwood Botanical Area. Two of the special areas have the potential to contain Class 3 to 5 paleontological resources: West Clear Creek RNA and the botanical area of Cottonwood Basin. The other areas have lower potential for invertebrate fossils and could have vertebrate fossils in caves and lava tubes.

The bedrock formations of the West Clear Creek RNA include Coconino Sandstone and the Kaibab Formation. These two sedimentary units contain invertebrate fossils and have been found to contain vertebrate tracks and trackways and shark teeth. Because the Kaibab Formation and Coconino Sandstone are cliff formers in West Clear Creek, they are predominantly Class 3 under the Probable Fossil Yield Classification, but potential exists for rock slabs containing tracks in the creek channels that are Class 5. An example of this is the Chelichnus tracks recently photographed within West Clear Creek in an area outside of the proposed RNA. However, these types of fossils are rare within a canyon setting.

The Cottonwood Basin Botanical and Geological Area is predominantly within Tertiary sedimentary bedrock units including Quaternary age alluvium, terrace gravel deposits, and the Verde Formation. The Verde Formation is known to contain tracks and trackways of camels and other large mammals and is ranked as a Class 4 to 5 geologic unit. Camel tracks are known to occur in the botanical portion of the special area within the Verde Formation and outside of the geological area (fumaroles locality), which is in a much older formation. Recording as paleontological resource sites is necessary for the camel tracks to preserve resource values.

Designed recreation management in special areas protects fossil-bearing sedimentary rocks by reducing mechanized travel. Mechanized travel can have direct and indirect impacts on fossil-bearing sedimentary rocks through direct destruction during construction or secondary erosion in areas surrounding constructed feature. For example, alternative B (modified) allows bicycling on designated trails in botanical and geological areas; otherwise, these special areas are not suitable for mechanized travel.

Designation of special areas encourages natural fire regimes, which typically includes fewer ground-disturbing activities to manage fire. In the West Clear Creek RNA and Cottonwood Basin Botanical Area, the effect would be fewer impacts to fossil-bearing sediments, thereby reducing inadvertent adverse effects to paleontological resources.

Under alternative B (modified), the management approach to conduct surveys in areas where there is high potential to encounter paleontological resources prior to ground-disturbing activities would benefit these resources on the forest by increasing the recovery of scientific and educational values in moderate and low potential fossil-yielding sedimentary rocks. In this way, alternative B (modified) allows for greater potential of protecting at risk paleontological resources by increasing overall knowledge of them across the forest. Uniform design criteria and mitigation measures described in

the alternative B (modified) would be used for identification and consistent management and protection of paleontological resource values across the forest.

Alternative C

Overall, the implementation of alternative C on paleontological resources would more beneficial than alternative A, and somewhat similar to alternatives B (modified) and D.

The effects of alternative C are the same as for alternative B (modified) because there are no changes in management direction, desired conditions, standards, guidelines, and management approaches. The additional recommended wilderness areas would protect resources equally, irrespective of land status, but may have the consequence of better protecting paleontological resource sites because there would be less forest management activities and fewer human disturbances or modifications. Enhancement and interpretation of paleontological resources may be more limited in the recommended wilderness areas and management areas because that could focus more attention on paleontological resources in the remote areas, which could lead to damage and vandalism.

The consequences of alternative C are the same as for alternative B (modified) for paleontological resources management. The addition of 8 management areas and 10 recommended wilderness areas does not change the effects to paleontological resources management because protection is uniform throughout the forest irrespective of land status or management area direction. This alternative recommends the same special areas as alternative B (modified) so the effects on paleontological resources management are the same

Alternative D

Overall, the implementation of alternative D on paleontological resources would be more beneficial than alternative B (modified), and somewhat similar to alternatives A and C.

Alternative D does not recommend additional wilderness areas and only proposes the Cottonwood Basin Geological Area as opposed to the combined botanical and geological area in alternatives B (modified) and C.

The effects of excluding the Cottonwood Basin Botanical Area on sedimentary rock formations with a high potential to yield paleontological materials has the potential for adverse effects to these resources. Potential paleontological resources (camel tracks) are known to occur in the Verde Formation within the area proposed for the botanical area, although these resources have not been recorded. Cottonwood Basin Geological Area is in a different geological formation from the Verde Formation; no known vertebrate animal tracks are present. Not identifying the Cottonwood Basin Botanical Area as a special area will reduce the ability of the forest to recover the scientific and educational values of known paleontological resources. Ground disturbance in the area could result in the loss of unidentified resources in sedimentary rocks with high potential to yield fossils Developing the Cottonwood Basin Botanical Area provides an opportunity to educate the public and develop interpretative materials on the interrelationships between geology, paleontology vegetation ecosystems, and endemic plants. Expanding education about the area’s paleontological resources can increase local stewardship for these resources.

The effects on moderate and low fossil-yielding sedimentary rocks under alternative D are similar to those under alternatives B (modified) and C. The Cottonwood Basin Geological Area does not contain sedimentary rocks with high potential to yield paleontological resources; therefore, the inclusion of this special interest area does not negatively affect high yield sedimentary rock formations. Consideration of other effects would occur on a project-by-project basis, and unlike alternative A, land managers would be able to use desired conditions to determine if there is the

potential for loss or destruction of paleontological resources without recovery of the scientific and educational values.

The potential for adverse effects under this alternative, in terms of the extent of paleontologically sensitive sedimentary rocks that may be affected, are greater than under alternatives B (modified) and C, and somewhat similar to the effects of alternative A. The authorization of active management also increases the possibility to adverse effects to paleontological resources through description of sedimentary rocks. Reduction of potentially adverse effects will occur on a project-by-project basis and be mitigated based on project-specific design criteria or mitigation measures.

Cumulative Effects

The timeframe and boundary of this analysis are the next 10 to 15 years and include NFS lands within the Coconino NF boundary and the local communities and national monuments within and closely adjacent to the forest boundary. Past, present, and future actions conducted on the Coconino NF that cumulatively contribute to the impacts to paleontological resources include site-specific ground-disturbing actions, site-specific ground-disturbing actions with secondary effects outside the area of direct impact (such as alluvial, colluvial, mass wasting of sedimentary rocks and aeolian transportation of sediments covering fossil-bearing rocks; inadvertent destruction, looting, and vandalism).

These types of activities on private and public lands beyond Coconino NF boundaries can have the same effect of destroying this non-renewable resource. As ground-disturbing activities increase (such as an increase in housing and associated urban infrastructure in the areas adjacent to the forest from regional population), the potential to affect sedimentary rocks containing potentially significant paleontological resources will continue. This will affect fossil-bearing sedimentary rocks and the overall preservation of paleontological remains in the cumulative effects area.

Known paleontological resources are present on other federally managed lands. Paleontological resources are located at nearby national monuments such as Montezuma Castle, Montezuma Well, and Tuzigoot. Paleontological resources are also present on national forests adjacent to the Coconino. Protection of paleontological resources occurs on all federally managed lands under the PRPA; management of resources on NFS lands also occurs under PRPA's implementing regulations 36 CFR 214, 215, and 291. The cumulative effect of managing paleontological values positively contributes to the overall knowledge of the Earth's history related to the cumulative effects area. Effective communication of this knowledge and partnership to protect these resources will foster direct stewardship of the resource, as well as the natural environments where they are located.

Alternative A has the greatest potential for negative cumulative effects to paleontological resources, because it provides the lowest level of consistent guidance for the management of paleontological resources during project implementation. Alternatives B (modified), C, and D provide improved protection of paleontological resources, as there is a framework for identification and recovery of the scientific and educational values of resources. All fossils, including invertebrate fossils, are regulated and protected under the PRPA under all alternatives. Alternatives B (modified), C, and D go even further and expressly provide for survey, record keeping, protection, and monitoring of paleontological resources. Federal law also provides for repository storage of paleontological resources and implementing regulations to establish a process for permitting and collection of paleontological resources and storage in a repository. Together, direction in the revised plan, laws, and regulations will work toward better knowledge about and protection of paleontological resources.

Vegetation and Fire

Healthy, resilient landscapes have greater capacity relative to nonfunctioning ecosystems to survive natural disturbances and large-scale threats to ecological sustainability, especially under changing and uncertain future environmental conditions, such as those driven by climate change and increasing human uses (Fulé 2008). Fire is a critical evolutionary force that has helped shape the vegetation of the Coconino NF. The resiliency of much of the forest is dependent upon fire as a frequent disturbance process. Given that the structure and function of much of the vegetation are closely intertwined with the natural role of fire across the majority of the Coconino NF, they are examined together in this section. Further information can be found in the Ecological Sustainability Report (USDA Forest Service 2009a) and vegetation modeling outputs. Smoke impacts as a result of fire are analyzed under the Air Quality section.

Affected Environment

Context

The Coconino NF has a high diversity of vegetative communities (also called vegetation types) due to its wide range of elevations, complex topography, and presence of perennial water. These communities are organized into Ecological Response Units (ERUs) and Riparian Areas. ERUs at the lowest elevations are more typical of Sonoran Desert while the highest elevation vegetative community, alpine tundra, is the only one in Arizona. In between, there are extensive areas of pinyon-juniper, ponderosa pine, and mixed conifer forests interspersed with grasslands and scattered pockets of aspen at higher elevations. Riparian vegetation lines stream courses of perennial and intermittent water (USDA Forest Service 2009a). Ponderosa pine and pinyon juniper ERUs dominate the forested landscape, covering approximately 76 percent of the forest (table 15).

Table 15. Ecological response units and riparian areas on the forest

ERU and Riparian Areas Description	Total Acres	Percentage of Forest
Desert Communities	62,877	3.4%
Interior Chaparral	50,471	2.7%
Cottonwood Willow Riparian Forest	1,324	0.1%
Mixed Broadleaf Deciduous Forest	5,926	0.3%
Montane Willow Riparian	3,568	0.2%
Wetland/Cienega	10,121	0.5%
Semi-desert Grasslands	89,701	4.9%
Great Basin Grasslands	92,842	5.0%
Montane Subalpine Grasslands	23,656	1.3%
Pinyon Juniper with Grass	261,454	14.2%
Pinyon Juniper Persistent	75,439	4.1%
Pinyon Juniper Evergreen Shrub	263,544	14.3%
Ponderosa Pine	797,171	43.3%
Mixed Conifer with Frequent Fire (Dry)	49,595	2.7%
Mixed Conifer with Infrequent Fire (Wet)	37,143	2.0%
Spruce-fir	13,946	0.8%
Alpine Tundra	939	0.1%

Fire Frequency and Departure

Fire was a natural disturbance that historically maintained reference conditions in the following 11 fire-adapted ERUs: Semi-desert Grassland, Great Basin Grassland, Montane Subalpine Grassland, Interior Chaparral, Pinyon Juniper with Grass, Pinyon-Juniper Evergreen Shrub, Pinyon-Juniper Woodland (Persistent), Ponderosa Pine, Mixed Conifer with Frequent Fire, Mixed Conifer with Infrequent Fire, and Spruce-Fir. Wildfires occurred infrequently in the Desert Communities and Alpine Tundra ERUs and these ERUs have different primary natural disturbances.

Table 17 summarizes current vegetation departure and trends relative to reference conditions, historical fire severity, and changes in fire return intervals by ERU. It also identifies primary threats to the ERUs and departure characteristics. Vegetation departures are focused on differences in vegetative states as they relate to ecosystem composition and structure. Historic and current fire return intervals show differences in disturbance patterns and relate to ecosystem process and function. The methods to determine vegetative departure are described in the Ecological Sustainability Report (USDA Forest Service 2009a). This approach was taken in combination with mid-scale vegetation data and vegetation distribution data that was updated after the original Ecological Sustainability Report.

Vegetation departure can reflect the disparity between current and reference conditions for individual characteristics and can typically be modeled into the future to show changes in departure over time depending on types and amount of treatments. Characteristics that were evaluated included: structure (vegetation states) of the dominant life forms (e.g., grass, shrub, and tree) and cover. Vegetation departure was assessed as low (0 to 33 percent), moderate (34 to 66 percent), or high (greater than 66 percent). Primary reasons for departures include: fire suppression and livestock grazing, lack of characteristic fire, and invasive exotic plants. While weeds are generally localized, present at low densities, or low-priority species in most ERUs, some ERUs face increased threats by exotic, invasive species because they can alter fire regimes, increase erosion, and compete with native plants.

Historically, over two-thirds of the Coconino NF had a fire return interval of less than 35 years (USDA Forest Service 2009a). Years of fire suppression, livestock grazing, and selective timber harvesting have resulted in missed fire return intervals and an unsustainable and degraded ecosystem condition within several ERUs (Covington and Moore 1994). Semi-desert Grassland, Great Basin Grassland, Montane Subalpine Grassland, Pinyon-Juniper with Grass, Ponderosa Pine, and Mixed Conifer with Frequent Fire ERUs have evolved with and are dependent on frequent fire to maintain their growth, structure, function, and health. Without fire in these vegetation types, the accumulation of debris on the forest floor would increase fire intensity and severity. When frequent fire ERUs are departed from their natural fire regimes, the resulting intensity and severity of wildfires can be uncharacteristically high. Such uncharacteristic fire also poses a greater threat to values at risk,[30] such as infrastructure, and public and firefighter safety (Moore et al. 1999). Fires that occur in departed ERUs adapted to frequent fire can result in rapid spread, high fire intensity, and high fire severity exceeding levels that managers can safely control (Moore et al. 1999). In these ERUs on the Coconino NF, fire exclusion has led to a dramatic change in ecosystem structure and function and increased potential for uncharacteristic fire behavior and effects.

Table 16 shows the number of burned acres by ERU on the forest. The column titled Wildfires shows the 10-year average annual number of acres. The column titled Wildfires that meet Resource

[30] Values at risk encompass a wide range of ecological and social values that could be negatively impacted by wildfire, including wildlife habitat, soils, watershed, riparian and water resources, heritage resources, and recreation amenities.

Objectives show the 3-year average of annual acres burned, and the column titled Planned Ignition shows the 10-year average of annual acres burned by prescribed fire.

Table 16. Acres burned by ERU

Vegetation Type (ERU)*	Wildfires (10 yr Average Acres)	Wildfires that meet Resource Objectives (3 yr Average Acres)	Planned Ignitions (10 yr Average Acres)	Number of Fires (10 yr Total)	Total Acres Burned (10 yr Total)
Desert Communities	2	0	0	49	17
Semi-desert Grassland	43	0	0	81	425
Great Basin Grassland	65	128	1,282	88	3,599
Montane/Subalpine Grassland	83	115	593	175	2,767
Interior Chaparral	150	0	17	50	1,537
Pinyon Juniper with Grass	2,389	71	131	287	25,863
Pinyon Juniper Evergreen Shrub	274	155	202	179	3,607
Pinyon Juniper Woodland (Persistent)	79	1	0	95	809
Ponderosa Pine	2,676	8,618	16,267	2,693	103,445
Mixed Conifer with Frequent Fire	189	769	537	155	5,273
Mixed Conifer with Infrequent Fire	592	9.0	44	220	6,079
Spruce Fire Forest	114	0	0	36	1,141
Alpine Tundra	0	0	0	0	0

*Areas classified under the urban/agricultural and water ERUs were not fully addressed in this analysis. The riparian forest types and wetland/cienega were also not analyzed here, but are instead covered in detail within the riparian specialist report (USDA Forest Service 2016c).

Table 17. Summary of vegetation and fire changes compared to reference conditions, ERU threats, and departure characteristics

ERU	Acres on the Forest (Percent of Forest)	Current Vegetation Departure[1]/ (Percent Departure)/ Future Trend	Historic Fire Return Interval/ Current Fire Return Interval/ Historic Severity[2]	Current Predicted Fire Return Interval and Fire Return Interval Trend	ERU Threats[3]	Primary Departure Characteristics
Desert Communities	62,877 (3.4%)	High (77%)/ Away	Not fire-adapted	Not fire-adapted	Invasive exotic plants; Road construction and maintenance	Increased late seral herbs and shrubs with >15% cover and invasion of exotic plant species
Semi-desert Grassland	89,701 (4.9%)	High (100%)/ Away	0 to 35 years 500+ years High Severity	High/Away	Fire exclusion/ uncharacteristic fire	Lack of characteristic fire disturbance, substantial shift to shrubs and trees, increased closed shrub states, and invasion of exotic plant species
Great Basin Grassland	92,842 (5.0%)	Low (10%)/ Away	0 to 35 years 500+ years High Severity	High/Away	Fire exclusion	Lack of characteristic fire disturbance, substantial shift to shrubs and trees, increased closed shrub states and invasion of exotic plant species
Montane/ Subalpine Grassland	23,656 (1.3%)	Low (32%)/ Away	0 to 35 years 500+ years High Severity	Moderate/Away	Fire exclusion/ uncharacteristic fire	Lack of characteristic fire disturbance, tree encroachment, increased closed shrub states, invasive plants
Interior Chaparral	50,471 (2.7%)	Low (26%)/ Static	35 to 100+ years 384 years High Severity; some 0 to 35 years Mixed Severity	Moderate/Away	Fire exclusion	Lack of characteristic fire disturbance
Pinyon Juniper with Grass[4]	261,454 (14.2%)	Moderate (55%)/ Away	0-35 years ** Low Severity to Mixed Severity	Moderate/Away	Fire exclusion/ uncharacteristic fire	Increased tree density and reduced understory species cover and diversity
Pinyon Juniper Evergreen Shrub	263,554 (14.3%)	Moderate (50%)/ Away	35-100+ years 500+ years Mixed Severity	High/Away	Fire exclusion/ uncharacteristic fire	Increased tree density and reduced understory species cover and diversity
Pinyon Juniper Woodland (Persistent)[4]	75,439 (4.1%)	Low (25%)/ Static	35-100+ years 192 years High Severity	Low/Away	Fire exclusion/ uncharacteristic fire	Increased tree density and substantial shift to small and medium sized trees, and reduced understory species cover and diversity

ERU	Acres on the Forest (Percent of Forest)	Current Vegetation Departure[1]/ (Percent Departure)/ Future Trend	Historic Fire Return Interval/ Current Fire Return Interval/ Historic Severity[2]	Current Predicted Fire Return Interval and Fire Return Interval Trend	ERU Threats[3]	Primary Departure Characteristics
Ponderosa Pine	797,171 (43.3%)	High (79%)/ Away	0-35 years 344 years Low Severity	High/Slowly Toward	Fire exclusion/ uncharacteristic wildfire; insects, disease, and invasive plants	Increased tree density and substantial shift to closed medium aged forest; reduced understory species cover and diversity; increased risk of uncharacteristic, high severity fire; and invasion of exotic plant species
Mixed Conifer with Frequent Fire[4]	49,595 (2.7%)	Moderate (64%)/ Away	0-35 years 130 years Low Severity	High/Very Slowly Toward	Fire exclusion/ uncharacteristic wildfire; invasive wildlife, insects, and disease	Increased tree density and substantial shift to closed medium-aged forest with shifts in species composition to more shade tolerant species, reduced understory species cover and diversity, increased risk of uncharacteristic, high severity fire
Mixed Conifer with Infrequent Fire[4]	37,143 (2.0%)	Moderate (62%)/ Away	35-100 year ** Mixed Severity	Moderate/Away	Fire exclusion/ uncharacteristic wildfire; invasive wildlife, insects, and disease	Increased tree density and shifts in species composition to more shade tolerant species, increased fuel loading and continuity
Spruce-Fir	13,946 (0.8%)	Moderate (66%)/ Toward	200+ years 500+ years High Severity	Moderate/Static	Fire exclusion/ uncharacteristic wildfire; invasive wildlife, insects, and disease (e.g., exotic spruce aphid)	Increased tree density and shifts in species composition to more shade tolerant species, increased fuel loading and continuity
Alpine Tundra	939 (0.1%)	Low (32%)/ Away	N/A	Not fire-adapted	None within Forest Service control.	None within Forest Service control.

1 Vegetation departure was assessed as low (0–33%), moderate (34–66%), or high (>66%).

2 Severity: Low-severity fires kill/topkill 25% or less of the dominant overstory and are primarily surface fires. Less than 75% of the dominant overstory is replaced in mixed-severity fires which are a combination of crown and surface fire. High-severity fires replace more than 75% of the dominant overstory as a crown fire. Also called stand replacement fire.

3 Within Forest Service control. See “Climate Change” section for analysis of potential climate change effects. Other ERU threats not within Forest Service control include excessive wildlife herbivory, drought, and fragmentation on lands off-forest. These other threats are considered in cumulative effects.

4 Pinyon-Juniper Woodland and Pinyon-Juniper with Grass were lumped together in the analysis in the “Ecological Sustainability Report,” as were the two mixed conifer types.

** Not available in the “Ecological Sustainability Report.”

The current conditions of the ERUs are summarized in table 17 and show different aspects of terrestrial ERUs on the forest. Eight of the 13 terrestrial ERUs analyzed are moderately to highly departed from vegetation reference conditions and represent approximately 85 percent of the total forest. Consequently, they are increasingly subject to uncharacteristic disturbances, such as stand replacing fire, especially in low severity-high frequency fire regime types. Departed ERUs with mixed-severity fire regimes are more prone to uncharacteristically large patches being created by high-severity fire due to uncharacteristically high small tree density, canopy bulk density, canopy cover, and fuel loads.

The composition and structure of these eight ERUs are departed from reference conditions and all except for the Spruce Fir ERU are trending away under current management. Over the anticipated 10- to 15-year lifespan of the revised forest plan, the forest has a limited capacity to substantially alter the trends in all ERUs and fully restore the desired conditions. Some of the limitations include budget, market conditions, competing resource objectives, weather, fuel conditions, fire management resource availability, and planning timelines.

Acres Treated

Over the life of the plan, approximately 290,000 acres have been mechanically treated forestwide. Prior to 1996, the forest treated about 199,000 acres and management strategy was focused on even-aged forest management, using the shelterwood system. The land management plan was amended in 1996 to incorporate updated direction for northern goshawks, Mexican spotted owls, and old growth and an uneven-aged forest management strategy. From 1988 to 2006, commercial vegetation treatments averaged 10,000 acres harvested per year (USDA Forest Service 2011j).

Snags

Snags are standing dead or dying trees. They can be of varying sizes, species, and decay classes. They include large snags, partial snags, and trees with broken tops, sloughing bark, wide lightning scars (greater than 4 inches wide) or snags capable of supporting large stick nests or nesting cavities. They are used for nesting, roosting, perching, and feeding sites by bats, birds, and mammals. There have been several snag studies on or near the forest. Ganey (1999) found a median of two snags per acre on the Coconino and Kaibab National Forests. The existing level of snags was calculated using the number of snags per acre currently present according to Forest Inventory Analysis data and can be compared to desired numbers (see table 18).

Table 18. Existing and desired number of snags by ERU

ERU	Existing 18+ inches d.b.h. per acre	Desired 18+ inches d.b.h. per acre
Pinyon Juniper Grassland	1.8	Scattered across landscape
Ponderosa Pine	1.3	1-2 snags
Mixed Conifer with Frequent Fire	3.3	3

* The desired ranges are from regional averages that represent each state. Regional guidance documents available on the Forest Service Southwestern Region website at: http://www.fs.usda.gov/main/r3/landmanagement/planning

The study by Ganey shows that current snag densities in these ERUs meet the guidelines in the current forest plan and are within the range of desired snags per acre by size and vegetation type.

Snag density and abundance can change in response to stand density, mixed or high-severity wildfire, insects and disease, and drought. In unnaturally dense stands, live trees may be more stressed due to increased competition for water and nutrients, more vulnerable to drought or insects

and disease, and may subsequently die. Wildfires can support the creation of new snags by killing existing live trees, and can also consume existing snags. Consequently, snag densities and the size class distribution of snags can change rapidly.

Old-growth Forest Components

The 1987 plan, as amended, requires that at least 20 percent of each forested ecosystem management area be developed or maintained for old-growth function and distributed in 100- to 300-acre stands. This approach managed Ponderosa Pine and Mixed Conifer stands (mid-scale) primarily for large trees, high stocking levels (70 to 100 square feet of basal area per acre), and high cover (40 to 60 percent), which tend to promote even-aged structure which is contrary to desired conditions. Current science points to old growth in frequent, low-severity fire regimes as being characterized by uneven-aged structure comprised of groups of trees and single trees interspersed in open grass–forb–shrub interspaces where old-growth tree components typically occur at the fine scale and structural features of old growth are distributed throughout the uneven-aged forest.

Wildland-urban Interface

The existing condition of three ERUs (Ponderosa Pine, Mixed Conifer with Frequent Fire and Pinyon Juniper with Grass) are addressed in greater detail in the environmental consequences section due primarily to their importance to our communities and their dominance of the landscape. Uncharacteristic fire behavior in these ERUs can lead to direct loss of community infrastructure including communication, transportation, energy and water supplies. Due to limited resources for treatments and elevated values adjacent to these ERUs, treatments have historically been accomplished almost exclusively in these three ERUs.

Ecological Response Units

The current conditions and trends for each of the ERUs are described below. More information on current condition and trends in these and other vegetation types can be found in the Coconino National Forest Ecological Sustainability Report (USDA Forest Service 2009a).

Desert Communities

On the Coconino NF, the Desert Communities ERU occurs in the Verde Valley where the Upper Sonoran Desert ERU merges with the forest. It ranges in elevation from 2,700 to 4,000 feet and covers approximately 62,877 acres (3.4 percent of the forest). It generally occurs in creosote-dominated, alluvial position and on old stream terraces adjacent to the Cottonwood Willow Riparian Forest type. Vegetation includes: desert scrub, grasses, and some succulents; however, some areas may be barren with abundant sand, rock, gravel, scree, or talus. The dominant species are creosote bush and mesquite, but other species may include: cat claw acacia, saltbush, desert broom, desert willow, Apache plume, hedgehog cacti, cholla, and tabosa grass. Desert Communities supports a unique community of endemic plants adapted to its calcium-rich soils; it also supports a plant, Arizona cliffrose, which is federally listed as endangered and only occurs in a very restricted portion of this ERU. Climate is the primary natural disturbance, and extreme climate variability (namely from temperature and precipitation) can cause temporary and localized shifts in vegetative composition.

According to reference conditions, Desert Communities was less fragmented and its vegetative structure was mostly open with sparse vegetation, as only 20 percent of the area contained dense vegetation of shrubs and understory species. Current conditions for this ERU are highly departed from reference conditions due to increased fragmentation from urbanization and increased density in vegetation structure. In addition, it contains a few invasive exotic plant species which, although they

are at low densities, they are widely dispersed across the area. The opportunity for their spread and colonization across new sites is high due to the presence of high-use roads such as State Routes 89A and 179, which have numerous weed infestations. The increased abundance and distribution of invasive exotic annual grasses is likely to result in an increase in the frequency and severity of wildfires.

Semi-desert Grassland

On the Coconino NF, the Semi-desert Grassland ERU occurs in the Verde Valley and is bounded by the Desert Communities ERU at lower elevations and Pinyon-Juniper Woodland or Interior Chaparral ERUs at higher elevations. Its elevation range is approximately 3,000 to 4,500 feet, and it covers approximately 89,701 acres (4.9 percent of the forest). It contains numerous roads and private land parcels, and it adjoins the communities of Camp Verde, Cornville, and Cottonwood. Current vegetation is dominated by perennial bunchgrasses; shrubs such as crucifixion thorn, velvet mesquite, cat claw mimosa, agaves, and turbinella oak; forbs which may include various buckwheat species; and trees such as Utah juniper and red-berried juniper. Wildfire is a natural disturbance within this ERU, and Semidesert Grassland is characterized by high-severity fire that occurs every 0 to 35 years.

According to reference conditions, the Semi-desert Grassland ERU was less fragmented than present (due to less human development), and the vegetative structure of the grasslands was more open with fewer trees and shrubs. Frequent low-severity fires were the principal driving force that formed and maintained the open structure of Semi-desert Grassland. Current conditions are highly departed from reference conditions as its extent has substantially decreased (namely due to increased private development), and fire frequency has decreased. Increased interface with developed private land increases the difficulty in maintaining frequent low-severity fire in this ERU. The departures in composition and structure that resulted from fire exclusion include alterations in many other subcomponents such as structural stage, stand age, canopy cover, and mosaic pattern, fuel composition, and fire frequency, severity, and pattern. The departed attributes do not allow for the natural fire disturbance cycle and, thereby, alter future fire disturbance processes. Lack of fire in this ERU would likely result in a trend away from reference conditions relative to fire return interval and a continued shift to shrub- and tree-dominated grasslands into the future. Due in large part to fire exclusion, about 30 percent of the Semi-desert Grassland on the south end of the forest have become so shrub and tree invaded that they have likely undergone a vegetation type conversion with little potential to be restored to open native grassland condition (USDA Forest Service 2009a). A few, widely distributed invasive exotic plant species are present, including red brome.

Great Basin Grassland

On the Coconino NF, the Great Basin Grassland ERU occurs at elevations between 4,800 and 7,500 feet and covers approximately 92,842 acres (5.0 percent of the forest). Great Basin Grassland is more arid than Montane Subalpine Grassland, and typical locations include Anderson Mesa and near Wupatki National Monument. Dominant species in this ERU are mostly grasses such as: Western wheatgrass, spike muhly, black grama, Indian ricegrass, threeawn, blue grama, fescue, James' galleta, and Sandberg bluegrass. Shrubs and, to a lesser extent, trees are also present and may include: sagebrush, salt brush, Ephedra, snakeweed, winterfat, rabbitbrush, sparse one-seeded juniper, and Colorado pinyon pine. Natural disturbances are: weather, natural soil movement (e.g., natural shrink-swell and surface cracking), and wildfire. Great Basin Grassland is characterized by high-severity fire that occurs every 0 to 35 years.

According to reference conditions, nearly three-fourths of the Great Basin Grassland ERU was in open, mid-development grasses and forbs with about one-fifth of it in late development shrubs and trees with open canopy. Current conditions are similar to reference conditions; however, some shrub and tree invasion is occurring along the edge of grasslands, and there has been a shift from small to large tree sizes. Although this ERU contains only a few invasive exotic species, some plants (camelthorn and diffuse knapweed) are ranked high for invasiveness. In addition, cheat grass is widely dispersed at low densities and could cause major changes in ecosystem integrity if not controlled. The departures in composition and structure that resulted from fire exclusion include alterations in many other subcomponents such as structural stage, stand age, canopy closure, and mosaic pattern, fuel composition, and fire frequency, severity, and pattern. Great Basin Grassland ERU has a low vegetative departure, with a trend away from reference conditions. Current predicted fire return interval departure is high and this ERU is trending away from reference conditions.

Montane/Subalpine Grassland

On the Coconino NF, the Montane Subalpine Grassland ERU occurs at elevations between 6,550 and 9,200 feet, with some small, unmapped patches existing at higher elevations. This ERU covers approximately 23,656 acres (1.3 percent of the forest), and consists of two subtypes: Montane Grasslands and Subalpine Grasslands. Montane grasslands occur above the Mogollon Rim and extend upward to about 7,800 feet in elevation and include locations such as Kendrick Peak, Antelope Park, and Mule Park. Species in this subtype include: muttongrass, mountain muhly, spike muhly, Arizona fescue, blue grama, red threeawn, squirreltail, yarrow, and pine dropseed. Subalpine Grassland typically occurs above 7,800 feet in areas such as Freidlan Prairie on the San Francisco Peaks. Species in this subtype include: pine dropseed, nodding brome, various sedges, Arizona fescue, mountain junegrass, mountain muhly, muttongrass, and squirreltail. In both subtypes, trees may also be present in trace amounts within the grasslands and along their periphery. The primary natural disturbance is wildfire, which reduces the number of tree seedlings and saplings that establish in grasslands, especially on the perimeter. Montane Subalpine Grassland ERU has a 0- to 35-year fire frequency and fires of high severity (surface fires most common) to mixed severity (i.e., less than 75 percent of the dominant overstory vegetation replaced).

According to reference conditions, Montane Subalpine Grassland was less fragmented before changes occurred in land ownership to private property owners and State and other Federal agencies. Its vegetative structure was more open or dominated by grass species; and it did not contain any invasive exotic species. This open structure was formed and maintained primarily by frequent low-severity fire entering from adjacent fire-adapted ERUs. Fire has been excluded within this ERU and in the adjacent fire-adapted ERUs. Consequently, vegetation structure is trending away from reference conditions. The departure is currently low but approaching moderate. Current predicted fire return interval departure is high and trending away from reference conditions. The departures in composition and structure that resulted from fire exclusion include tree encroachment and alterations in the pattern and diversity of vegetation resulting from fire intrusions. The presence of a few invasive species that are ranked high for invasiveness, such as leafy spurge, also represent a departure from reference conditions.

Interior Chaparral

On the Coconino NF, the Interior Chaparral ERU occurs at lower elevations, mostly in the Verde River basin, between the Semi-desert Grassland and Pinyon-Juniper Evergreen Shrub ERUs. Its elevation ranges from 3,750 to 7,300 feet, and it covers approximately 50,471 acres (2.7 percent of the forest). Its location varies from widely scattered pockets within grasslands and woodlands to more extensive areas on steep slopes. Vegetation includes: turbinella oak, mountain mahogany,

manzanita, desert ceanothus, silk tassel, Stansbury cliffrose, and sumac. Interior Chaparral is characterized by high-severity fire that occurs primarily every 35 to 100+ years; however, some mixed-severity fire may occur every 0 to 35 years.

According to reference conditions, Interior Chaparral is composed of 93 percent dense shrubs with a closed canopy and no understory, 5 percent grass and open shrubs, and 2 percent grass and forb regeneration. Current vegetation conditions are similar to reference conditions (low departure) with a static trend in the ERU's extent, structure, and composition. Current predicted fire return interval departure is high and trending away from reference conditions. A few invasive plant species are present in this ERU and may pose a risk to vegetation in the future if populations increase in frequency or extent.

Pinyon-Juniper with Grass

On the Coconino NF, the Pinyon-Juniper with Grass ERU occurs at elevations between 5,000 and 8,300 feet and covers approximately 261,454 acres (14.2 percent of the forest). This ERU is distributed in upland and valley settings or where local conditions are inherently favorable for grasses, and it is often found on moderately deep soils and gentle topography. Tree species includes: pinyon pine and Utah and one-seed juniper (which are most common) and alligator juniper at higher elevations. Its understory consists of annual and perennial grasses (with forbs) including: blue grama, needle and thread grass, and western wheatgrass. Shrubs may be present, but they are a minor component. Pinyon-Juniper with Grass is characterized by low-severity to mixed-severity fire that occurs every 0 to 35 years. This classification is assuming that the dominant life form is the pinyon and juniper; therefore, the severity is based on fire effects to the Pinyon-Juniper, rather than the grass component. The tree component would generally not be consumed/replaced, but the grass would burn as stand-replacement. The shrub component would generally burn as mixed-severity.

According to reference conditions, Pinyon Juniper with Grass was generally uneven-aged and open in appearance. Trees occurred as individuals, but occasionally in smaller groups, and they ranged from young to old. Shrubs were scattered and a dense, nearly continuous herbaceous understory included: native grasses, forbs, and annuals. Romme et al. (2009) estimated that probable fire behavior would be moderate surface fire spread, limited torching, and low tree mortality (in mostly smaller stems) in this ERU when conditions are typical of the 80th percentile fire weather following a single ignition event in pinyon and juniper vegetation with significant grass cover and sparse tree density. Under extreme fire weather conditions, there would be probable extensive surface fire spread and torching, and moderate mortality across all tree sizes.

Current conditions are moderately departed from reference conditions and are trending away. Pinyon Juniper with Grass is at high fire return interval departure and trend away from reference conditions. Within this ERU, there are currently more trees per acre and greater cover than under reference conditions due to fire exclusion and weather patterns which have favored tree germination and establishment. As a result, understory abundance and diversity has decreased. In severe cases of tree encroachment, former grasslands and savannas have undergone a vegetation type conversion, including a change in fire regime, to juniper or pinyon juniper woodlands. The expansion of pinyon and/or juniper into previously nonwooded areas is resulting in a more homogenous landscape that, in some areas, is suppressing understory herbaceous growth and consequently the potential for surface fires. The pronounced departures in composition and structure that resulted from fire exclusion include alterations in many other subcomponents such as: structural stage; stand age; canopy cover; mosaic pattern; fuel composition; and fire frequency, severity, and pattern. The departed attributes do not allow for the natural fire disturbance cycle and, thereby, alter future fire disturbance processes.

Areas that have been affected by the Ips bark beetle infestation over the past decade, however, are expected to trend toward reference conditions.

Pinyon-Juniper Evergreen Shrub

Pinyon-Juniper Evergreen Shrub ERU occurs at elevations between 4,000 and 6,900 feet and covers approximately 263,554 acres (14.3 percent of the forest). It usually occupies hills, plains, mountains, and escarpments below the Mogollon Rim. This ERU is dominated by open to closed shrub canopy of evergreen oaks, such as turbinella oak and some tree forms of Emory and Arizona white oak and Stansbury cliffrose. Codominant species include single-needle pinyon pine and Utah juniper, and some areas contain alligator juniper and Arizona cypress. A grassy understory may be present in areas with decreased tree cover, and herbaceous ground cover is dominated by warm season grasses including blue and sideoats grama and needle and thread grass. Pinyon-Juniper Evergreen Shrub is characterized by mixed-severity fire that occurs every 35 to 100+ years.

According to reference conditions, Pinyon-Juniper Evergreen Shrub was dominated by shrubs and medium to very large open, grown trees, and invasive exotic species were not present. Current conditions are moderately departed from reference conditions as this ERU is now less extensive and mid-scale vegetation analysis indicates a shift to more closed tree canopies and a loss of herbaceous understory. There are a few invasive species within Pinyon-Juniper Evergreen Shrub, but their populations are few in number and acreage. This ERUs current predicted fire return interval departure is high and trending away from reference conditions.

Pinyon-Juniper Woodland

On the Coconino NF, Pinyon-Juniper Woodland (also called Persistent Pinyon Juniper Woodland) occurs at elevations between 3,000 and 7,500 feet and covers approximately 75,439 acres (4.1 percent of the forest). Pinyon-Juniper Woodland is characterized by high severity fire that occurs every 35 to 100+ years. It is located mainly in the north and east portions of the forest on the lower slopes of mountains and upland rolling hills. This ERU ranges from sparse stands of scattered, small trees growing on poor substrates to relatively dense stands of large trees on more productive sites. However, tree density and cover may fluctuate in response to disturbance and climatic variability. Tree species include: pinyon pine and Utah and one-seed juniper (which are most common) and alligator juniper at higher elevations. Shrubs may include: Stansbury cliffrose, Gambel oak, saltbrush, big sagebrush, and limited areas of turbinella oak and manzanita. Understory species is mostly comprised of annual and perennial grasses including: blue grama, needle and thread grass, and western wheatgrass. Natural disturbances in Pinyon Juniper Woodland include endemic levels of insects and disease and wildfire.

According to reference conditions, Pinyon Juniper Woodland was mostly open with a mosaic of small, medium, and large trees overtopping a herbaceous understory. Fires were more frequent and generally did not “thin from below” (i.e., they did not kill predominantly small trees), but rather tended to kill all or most of the trees, regardless of size, within the places that burned. In addition, invasive species were not present. Historical fire rotations (i.e., the time required for the cumulative area burned to equal the size of the entire area of interest) varied from place to place. Overall, current vegetative conditions have a low departure with a static trend from reference conditions. This ERU’s current predicted fire return interval is moderately departed and trending away from reference conditions. Areas that are overstocked with trees are expected to trend away, and the remaining areas are expected to have a static trend.

Ponderosa Pine

Ponderosa Pine is the largest ERU on the forest. It occurs from 5,300 to 8,200 feet in elevation and covers approximately 797,171 acres (or approximately 43.3 percent) of the forest. In addition to the dominant overstory species (ponderosa pine), other trees include: Gambel oak; Douglas-fir; pinyon pine; Utah Rocky Mountain and alligator juniper; and aspen in small, localized areas. Snags (or dead standing trees) are also present. Understory vegetation includes a mixture of shrubs and grasses including: manzanita, Fendler's ceanothus, Arizona fescue, mountain muhly, screw leaf muhly, and blue grama. In some areas, ponderosa pine occurs as savannah with extensive grasslands interspersed between widely spaced clumps or individual trees (USDA Forest Service 2009a). Ponderosa pine is the host to several different bark beetles, insect defoliators, and dwarf mistletoe.

According to reference conditions, ponderosa pine primarily occurred as open, all-aged forests, with a widespread herbaceous understory, and its composition and structure was maintained by frequent, low-severity fires and endemic levels of insects and disease. Ponderosa Pine on the Coconino NF is characterized by low-severity fire that occurs on average, every 7 years, ranging between 0 to 20+ years. Historic logging practices (e.g., railroad logging on the north side of the forest) originating in the 1880s focused on even-aged silvicultural systems, particularly clearcutting. Logging companies purchased timber rights from the transcontinental railroads which had been granted "checkerboarded" or alternating sections of land from the Federal Government. Many of these sections in the north were clearcut prior to establishment of the Coconino NF in 1908 (NPS 1995). However, the railroad line only penetrated as far south as Allen Lake, into the northern edge of what is now known as the Mogollon Rim Ranger District.

Early reports indicate that bark beetle activity was less frequent, extensive, and damaging in the Southwest than other western regions (USDA Forest Service 2009a). This includes periodic outbreaks, especially with droughts, or in the absence of controlling disturbance agents. There were widespread bark beetle outbreaks on the forest in the mid-1920s, late 1930s, mid-1960s, late 1970s through the early 1980s, and late 1990s through the mid-2000s (Lynch et al. 2007).

Dwarf mistletoe abundance is probably greater today than in the 1800s, mostly because of the lack of natural wildfire and increase in the abundance of host trees, (USDA Forest Service 2010a). Hessburg and Beatty estimated that 32 percent of the commercial acres of ponderosa pine on the Coconino NF were infected with dwarf mistletoe, a nearly 8 percent increase from the levels found in a similar survey only 30 years earlier (Hessburg and Beatty 1985; as cited in Lynch et al. 2007).

Current vegetative conditions within Ponderosa Pine are highly departed and trending away from reference conditions. The current predicted fire return interval departure is high and trending slowly toward reference conditions. Ponderosa Pine differs from reference conditions in that the amount of cover is higher, trees are denser and more continuous, fuel loads are higher, and more even aged stands of trees exist due to the exclusion of fire. Open canopy stands are extremely deficit. Stands growing under these conditions are less resilient and sustainable over time, because they are under greater competitive stress and are more susceptible to threats including: uncharacteristic wildfire; invasive species; and widespread infestations of disease. Another consequence of fire exclusion and the interruption of the frequent fire regime is the decline in understory species diversity and abundance. This condition exists because the resulting higher tree density can both (1) contribute to the buildup of a dense mat of pine needle litter that suppresses vegetation, and (2) reduce the amount of sunlight reaching the forest floor. Secondary threats include uncharacteristically intense wildfire and increased susceptibility to insect and disease from increased plant competition for water during times of drought.

Mixed Conifer with Frequent Fire

On the Coconino NF, Mixed Conifer with Frequent Fire ERU (also called Dry Mixed Conifer) occurs at elevations ranging from 7,000 to 8,900 feet and covers approximately 49,595 acres (2.7 percent of the forest). It is located between lower elevation Ponderosa Pine and Mixed Conifer with Infrequent Fire ERUs and the higher elevation Spruce-Fir ERU. This ERU is dominated by mainly shade-intolerant trees such as ponderosa pine, southwestern white pine, limber pine, quaking aspen, and Gambel oak, and there is a lesser presence of shade-tolerant species such as white fir and blue spruce. Additionally, shade mid-tolerant species, such as Douglas-fir, are common; aspen may occur as individual trees or small groups; and maple is generally found in wetter sites, canyons, and draws. An understory of various grasses, forbs, and shrubs is also present. The primary natural disturbances in this ERU are wildfire and endemic levels of insects and disease.

The normal fire regime is generally considered to be low severity, similar to Ponderosa Pine, with fire return intervals between 0 and 35 years. Like Ponderosa Pine, this ERU co-evolved with fire; therefore, fire was the driving force that formed and maintained the openness of stands and appropriate conditions for the maintenance of early succession species and made them less susceptible to insect and disease.

According to reference conditions, Mixed Conifer with Frequent Fire was a mostly open landscape and was dominated (in terms of basal area) by largely mature and old trees; however, all age classes of trees were present. A widespread herbaceous understory was also present. Current vegetative conditions are moderately departed and trending away from reference conditions, namely because of the lack of fire. Current fire frequency is far below reference conditions and is trending away. As a result of fire exclusion, shade-tolerant species, such as white fir, are increasing in the understory. Consequently, tree density is high in most places, and conditions for early succession species are not being maintained or created.

Douglas-fir dwarf mistletoe is thought to be currently more widespread and continuous in distribution than in reference conditions due to the exclusion of fire and the increased amount of dense multilayered stands (USDA Forest Service 2009a). Based on present understanding of dwarf mistletoe ecology, increases in host abundance over the past 150 years, decreases in fire frequency, and evidence of previous forest conditions and fire regimes, it can be inferred that southwestern dwarf mistletoe abundance (severity and distribution) was likely lower historically and current conditions are likely similar to those described by Hessburg and Beatty (1985). White pine blister rust, which was recently discovered for the first time in eastern Arizona, may also begin to appear on the Coconino NF. This non-native disease is one of the most damaging tree diseases in North America, affecting white pines of all sizes. Compared to reference conditions, and considering the likely introduction of white pine blister rust, the level of insect and disease in this ERU is outside of the historic range of variability. Mixed Conifer with Frequent Fire, however, has few weed species (USDA Forest Service 2009a).

Aspen is distributed throughout this Mixed Conifer with Frequent Fire as small groups and individual trees. Aspen populations are declining in this ERU because of fire exclusion, but also due to insect defoliators, drought, and heavy ungulate browsing.

Mixed Conifer with Infrequent Fire

On the Coconino NF, the Mixed Conifer with Infrequent Fire ERU (also called Wet or Mixed Conifer with Aspen) occurs at elevations between 8,000 and 10,400 feet and covers approximately 37,143 acres (2.0 percent of the forest). It occurs on mountain slopes such as the San Francisco Peaks and may also occur in canyons and north-facing slopes such as on Hutch Mountain and

Mormon Mountain. This vegetation condition for this ERU is currently moderately departed and trending away from reference conditions. The fire return interval is moderately departed and trending toward reference conditions. Aspen occurs as individuals and groups that shift in location over time throughout this ERU. Aspen establishes in response to canopy gaps created by disturbances. Within this ERU, aspen is declining primarily due to a lack of disturbance, and insect defoliators, drought, and heavy ungulate browsing. Dominant and co-dominant species include: Douglas-fir, New Mexico locust, southwestern white pine and limber pine, and late seral species such as maple, white fir and blue spruce. Ponderosa pine may be present in minor proportions. The absence of substantial quantities of Engelmann spruce and/or corkbark fir distinguishes Mixed Conifer with Infrequent Fire from the Spruce Fir ERU. Its understory contains a wide variety of shrubs, grasses, and forbs, and it generally has more forbs, sedges, mosses, and liverworts than Mixed Conifer with Frequent Fire and more leaf litter because there are more deciduous species. Disturbances typically occur at two temporal and spatial scales: large-scale infrequent disturbances (mostly mixed-severity fires at 35- to 200-year intervals) and small-scale, frequent disturbances (e.g., fire, insect, disease, wind).

Nearly 80 percent of this ERU is dense, with higher canopy closure, indicating that a greater percentage of this ERU is in a late successional state than was present under reference conditions. Consequently, shade-tolerant species are more prevalent and early successional, more fire tolerant species are declining. The risk of uncharacteristically large and severe fires is higher than reference conditions. Mortality due to insect and disease is likely to continue because of the high proportion of dense stands, lack of fire, and the possible introduction of white pine blister rust, which was recently discovered for the first time in eastern Arizona. White pine blister rust is one of the most damaging tree diseases in North America, affecting trees of all sizes, but has not been detected on the Coconino.

Spruce-Fir

On the Coconino NF, the Spruce-Fir ERU occurs at elevations between 8,400 and 12,000 feet and covers approximately 13,946 acres (less than 0.8 percent of the forest). It is within the Kachina Peaks Wilderness and represents some of the coldest, wettest, and highest elevation sites on the forest. Spruce-Fir is often dominated by Engelmann spruce, but contains other species depending on elevation. The understory commonly includes: currants, maples, honeysuckle, common juniper, alpine clover, and sedges. Disturbances in Spruce-Fir typically occur at two temporal and spatial scales: large-scale infrequent disturbances (mostly fire) and small-scale frequent disturbances (e.g., fire, insect, disease, wind). This ERU is characterized by infrequent, high-severity fire (fire return interval of over 200 years). Other major disturbances were wind- or snow-related.

According to reference conditions, structure, and composition of the Spruce-Fir ERU was governed by complex interactions between multiple disturbance agents. Spruce beetle outbreaks cause extensive tree mortality and modify stand structure by reducing the average tree diameter, height, and stand density while dramatically increasing fuel loading. Insect and disease populations will often remain endemic for hundreds of years as the younger forests mature. Spruce-Fir forests characteristically experienced infrequent, high-severity fires, typically following epidemic beetle infestations in susceptible, mature forests. Invasive exotic species were not present.

Vegetative structure is moderately departed and its trend is toward reference conditions. Current predicted fire return interval departure for Spruce Fir is moderate with a static trend. There is a surplus of younger age classes and fewer old age classes due to extensive wildfires that occurred in the early 1900s. Because the majority of this ERU (80 percent) is located in designated wilderness and has been subject to little management, except for fire suppression, it has either taken on old-growth conditions or is trending toward developing old growth. Although approximately 340 acres

are affected by the spruce beetle, this acreage is considered to be within historic levels. Two invasive exotic species (Dalmatian toadflax and houndstongue) are present in Spruce-Fir, but their populations are few in number and acreage and they have a low ranking for invasiveness. Therefore, they are not considered a threat to this ERU. An exotic spruce aphid (*Elatobium abietinum*) became established in the late 1990s, and may pose a risk to spruce species if populations expand (Lynch et al. 2007 and USDA Forest Service 2009a).

Alpine Tundra

On the Coconino NF, about 939 acres of the Alpine Tundra ERU occur in the Kachina Peaks Wilderness (approximately 0.1 percent of the forest), beginning around 10,600 feet in elevation and continuing to the top of Humphrey's Peak, the highest point in Arizona. It is the only area of Alpine Tundra in Arizona, and it is one of the southernmost extents of this ERU in the United States. Alpine Tundra consists of three main habitat associations: boulder fields, talus slopes, and meadowlike areas. It is typically barren with sparse vegetation including: grasses, forbs, lichens, and low shrubs. Dwarf, wind-twisted trees are present near the tree line where trees transition to Alpine Tundra vegetation. One of the plants it supports, San Francisco Peaks ragwort, is federally listed as threatened. Alpine Tundra is not a fire-adapted ERU; instead, its natural disturbance processes are related to episodic weather events including extreme temperatures, solar radiation, winds, avalanches, and moisture. While wildfires and invasive exotic species have had little effect on this ERU, off-trail recreation can trample plants and damage habitat, especially outside of winter.

Current vegetation conditions in Alpine Tundra are similar to reference conditions (low departure) but are trending away. The trend away from reference conditions is associated with recreation impacts (off-trail use) and the risk of localized warmer and drier climate trends. If these climate trends persist, they could produce pronounced changes in the ERU's composition and structure by increasing plant mortality, plant stress, and shifts toward meadow species rather than talus slope species. Invasive species are currently absent from this ERU, namely because of its remoteness from roads, lack of management activities, and extreme environmental conditions.

Sub-ERU Tree Features

Aspen

Aspen occurs in multiple ERUs across the forest on cool, wet sites. It is an important component of Mixed Conifer vegetation types and a minor component of Ponderosa Pine and Spruce-Fir vegetation types. Aspen occurs as individuals and groups that shift in location over time throughout the landscape as a component of other ERUs. It establishes in response to canopy gaps created by disturbances. Over time, individuals and groups will decline and will be replaced by the surrounding conifers, but will then reestablish in new areas as disturbances create the appropriate early successional conditions. Aspen in the Southwest have been declining for decades. This decline is primarily attributable to altered fire regimes that have decreased the incidence of scattered overstory openings. Insect defoliators, drought and the inability of aspen regeneration to survive heavy browsing by ungulates has also encouraged the conversion of existing aspen patches to coniferous forest (USDA Forest Service 2009a). Aspen mortality has been greatest at lower elevation.

According to a monitoring project between 2000 and 2007, the Coconino NF experienced an accelerated decline of aspen especially at sites below 7,500 feet elevation (Fairweather et al. 2007). Drought conditions are expected to exacerbate this decline as stressed trees become more susceptible to damaging agents and mortality. Aspen at higher elevations would become increasingly susceptible and higher rates of mortality should be expected. As overstory aspen weaken and die and competition from conifers increase, successful sprouting (suckering) is expected to decline.

Combined with the lack of fire disturbances which provide opportunities for the establishment of aspen regeneration across the landscape, heavy browse pressure from ungulates, drought, frost, and insect defoliation can prevent aspen existing regeneration from reaching maturity, except within fenced areas. Extensive mortality of the established aspen component combined with a lack of fire disturbance and almost complete regeneration failure at lower elevations (lower than 8,500 feet), indicates that future persistence of aspen on the Coconino NF is not assured, except in relict locations at lower elevations (Lynch et al. 2007; Fairweather et al. 2007). Fairweather et al. (2007) found that between 2000 and 2007, affected sites at less than 7,500 feet in elevation experienced, on average, greater than 95 percent mortality; sites located at elevations of 7,500 to 8,500 feet had 61 percent rate of mortality; and 16 percent mortality was observed at sites higher than 8,500 feet in elevation.

On the Coconino NF, aspen most often occurs in small localized areas and is included with several different ERUs. It was not included in the vegetation models because aspen occurs at too small of a scale to be appropriately modeled (USDA Forest Service 2009a); however, based on the substantial declines in presence across the landscape and the threat of warming climates and fire suppression, the vegetation condition of aspen is believed to be highly departed with a trend away from desired conditions. The fire return interval departure is moderate and trending toward desired conditions based on its relatively infrequent historic fire return interval, the current fire return interval of associated ERUs and its recent history of wildfire acreage burned.

Aspen has been selected as an ecological indicator for alternatives B (modified) through D and is included in the monitoring program for these alternatives.

Maple

In Arizona, bigtooth maple (*Acer grandidentatum*) occurs as a shade-tolerant, seral understory tree or shrub in Douglas-fir, white fir, Engelmann spruce and subalpine fir (*Abies lasiocarpa*) habitat types (DeVelice and Ludwig 1983, as cited in Tollefson 2006). On the Coconino NF, this species is most prominent in the Mogollon Rim Botanical Area, a 339-acre white fir–bigtooth maple community, and represents a unique vegetation type found in Arizona only at a few locations along the Mogollon Rim. Bigtooth maple is a deciduous, small tree or shrub of variable size, and its form is dependent upon the moisture regime. In canyon bottoms and along streams it grows as a tree with single or multiple trunks reaching 50 feet (15 meters) tall and 1 foot (30 centimeters) in diameter, while on dry canyon slopes it grows as a shrub with 2 or more stems reaching 26 feet (8 meters) tall. It occupies cool, shaded draws and intermittent stream drainages in the high mountains and plateaus of central and southern Arizona (Little 1950, as cited in Tollefson 2006). It is currently more abundant in the bottom than in the top of snowmelt drainages on the Mogollon Rim in central Arizona (Martin 2001, as cited in Tollefson 2006).

The white fir–bigtooth maple habitat type typically occurs along stream courses. They are generally tolerant of fire, sprouting from root crown when stems are burned. Sprouting is most likely to occur from young stems on moist sites where high moisture content in fuels results in low-severity burns (Harper et al. 1992, as cited in Tollefson 2006). As maple canopy increases, shading reduces understory fuel buildup and fuel moisture remains higher, decreasing the susceptibility of the area to high-severity fires (Bradley et al 1992, as cited in Tollefson 2006). Bigtooth maple is a dominant species in broadleaf riparian woodlands in Arizona, which are used by a variety of wildlife species (Brown et al. 1977, as cited in Tollefson 2006).

Gambel Oak

Gambel oak occurs with ponderosa pine and mixed conifer with frequent fire in Arizona, growing primarily as an understory or mid-story tree. Most fire history studies have discovered that surface fires burned ponderosa pine-Gambel oak forests on average at least once every 13 years or less before policies of fire exclusion beginning in the late 1800s (Abella and Fulé 2008a). Similar to pure ponderosa pine forests, fire exclusion, wood harvesting, livestock grazing, and other factors have altered forests with Gambel oak forests since Euro-American settlement in the late 1800s. Research published to date suggests that densities of small diameter oaks have sharply increased in the past 140 years in ponderosa pine–Gambel oak forests (Abella and Fulé 2008b). Less clear, however, is whether large-diameter oaks have dwindled because of firewood harvest or other factors (Mast 2003). Empirical evidence suggests that increasing densities of conifer species are shading out Gambel oak, contributing to its decline. Diameter distributions at Camp Navajo, Arizona, in 1883 and in 1994 to 1995, suggest that densities of oaks greater than 10 inches (25 centimeters) in diameter have actually increased slightly since 1883 (Abella and Fulé 2008b). Overall, the number of small-diameter oaks on the landscape is higher than under reference conditions.

Alligator Juniper

Alligator juniper occurs within several ERUs, including Ponderosa Pine, Pinyon-Juniper with Grass, Pinyon-Juniper with Evergreen Oak, and Mixed Conifer with Frequent Fire; often occurring in transition zones. Species dominance among junipers appears to be related to elevation and precipitation patterns. Due to its ability to resprout after fire, alligator juniper may achieve dominance on a post-fire site more rapidly and, where it occurs, more frequent fires would be required to suppress small trees and maintain a savanna structure (Miller and Rose 1999). Alligator juniper in north-central Arizona falls below the historical range for mean tree height and mean tree diameter. The smaller mean tree sizes potentially indicate sites are more heavily dominated by a greater number of young trees than occurred historically, but the number of large trees has not changed substantially (Gori and Bate 2007).

Aerial photographs from 1935 and 1991 were used in an analysis of vegetation change in southwestern New Mexico. Dramatic changes occurred on gently sloping mesas where relatively dense stands of alligator juniper replaced former grasslands and juniper savannahs. During the 56-year period, grasslands and juniper savannas decreased from a combined 15 percent of the study area to less than 2 percent (Miller and Rose 1999). Similar encroachment by alligator juniper is occurring in grassland vegetation types on the Coconino NF.

Blue Spruce

Blue spruce occurs as an infrequent component of mixed conifer ERUs particularly in stream bottoms and meadow borders across the Coconino NF. The shallow rooting habit typically restricts it to moist sites where water is close to the surface (Pavek 1993). In general, it dominates habitats that are too warm for Engelmann spruce and subalpine fir and that are wetter than those typically occupied by ponderosa pine. Shrub associates include Gambel oak, as well as alders and willows on the moister sites. It is most frequently associated with Douglas-fir and ponderosa pine, and with white fir on mesic sites. Blue spruce is seldom found in large numbers, but on streamside sites it is often the only coniferous species present. Blue spruce is classed as intermediate in terms of shade tolerance.

Spruce aphid is an exotic insect that established on the San Francisco Peaks about 1999. This insect feeds on tree sap through needle stomata and damages Engelmann spruce and Colorado blue spruce of all size classes. Blue spruce, however, is less susceptible to spruce aphid than is Engelmann

spruce, so in some areas it would replace Engelmann spruce if heavy aphid mortality occurred (Lynch et al. 2007).

Environmental Consequences

Forestwide Consequences

In general, alternative A would result in higher fire severity relative to the action alternatives (alternatives B (modified), C, and D), primarily due to constraints on wildfires managed for resource objectives in wildland-urban interface and wilderness (1987 Plan, pages 111-112; 137;140; 155;157; 165;170). The constraints in these areas would result in fewer acres treated in the short term and in the long term. The action alternatives make managing wildfires for resource objectives more probable (forestwide) by having clear objectives that are consistent with fire treatment (FW-TerrERU-PP-O-3, FW-TerrERU-PJ-O-2, FW-TerrERU-PJ-O-3). In contrast, alternative A lacks substantial emphasis on the natural role fire in restoring and maintaining the composition, structure, and function of fire-adapted ERUs. The action alternatives have guidelines such as FW-Fire-G-1 and FW-Fire-G-2 that emphasize fire treatment in the wildland-urban interface and encourage the use of fire to move ERUs toward desired conditions. In addition, there are forestwide management approaches that emphasize fire treatment planning and implementation (Fire Management-Management Approaches).

Although all alternatives recognize the importance of prescribed fire in the wildland-urban interface, only the action alternatives explicitly allow for the use of wildfires managed for resource objectives in the wildland-urban interface and Oak Creek Canyon. The action alternatives also more clearly articulate the need to manage for the most resilient and least volatile forest composition and structure in the wildland-urban interface (FW-WUI-DC-2, FW-WUI-DC-3, FW-WUI-DC-4, FW-WUI-DC-5, FW-WUI-DC-6, FW-WUI-DC-7, FW-WUI-DC-8, and FW-WUI-DC-9). This more resilient condition would take the form of more open stands with lower tree densities and fuel loads (including logs and snags). Similarly, action alternative guideline FW-Fire-G-2 supports fire treatment to achieve desired conditions in wilderness areas.

Outside of wildland-urban interface, wilderness areas, and special areas, the primary difference in potential fire treatment between the alternatives is in desired conditions. Alternative A does not have clearly stated desired conditions that emphasize the ecological importance of fire. All of the action alternatives have desired conditions that highlight the need for fire to achieve and/or maintain a fire-adapted ERU's composition, structure, and function. Examples of this are the following desired conditions that are common to all action alternatives: FW-TerrERU-PP-DC-2, FW-TerrERU-PP-DC-3, FW-TerrERU-MC-MCFF-DC-4, FW-TerrERU-MC-MCFF-DC-8 and FW-TerrERU-PJ-DC-4.

Wilderness

There are currently approximately 156,374 acres across 10 designated wilderness areas on the Coconino NF. Of these, 151,333 acres are managed under the Coconino forest plan. Under alternative B (modified), an additional 3 areas (8,733 acres) are recommended for designation. Under alternative C, an additional 13 areas (91,757 acres) are recommended for designation. As described above, alternative A would result in fewer acres treated and higher fire severity (relative to alternatives B (modified), C, and D) mainly due to constraints on wildfires managed to meet resource objectives in wildland-urban interface, Oak Creek Canyon, and wilderness.

Generally, when an area is designated as wilderness, the applicable laws and policies have the potential to affect the likelihood of future fire treatments. Not only would mechanical treatment within the wilderness be prohibited, but also the use of any mechanical tools. This means that fire

crews would not have access to vehicles to enter or exit area and tools such as chainsaws would be unavailable. When travel within the area is restricted to hiking, the safety risk to firefighters is greater because of the inability to quickly evacuate the area in the event of an unexpected change in fire behavior. Furthermore, only hand tools would be available to contain and control fire spread; this would create a scenario where the fire has a greater potential to escape containment. While many other site-specific factors that can change over time are known to influence the decision to suppress or manage wildfires for resource objectives (see methods section), the limitations associated with operating in wilderness are expected to increase the chance of a suppression decision.

Alternative A

Under alternative A, there are restrictions to the types of activities that can occur within designated wilderness. Some of these restrictions are based on the provisions of the Wilderness Act (1964) and some are based on the direction provided in the 1987 plan. The Wilderness Act establishes that the use of motorized equipment is not compatible with wilderness objectives and as a result the vegetation may not be managed through mechanical harvest activities. In general, as the proportion of each ERU that is subject to wilderness management constraints increases, there is also a greater potential to decrease the rate at which the ERU can move toward the desired condition. However, if wildfires can be appropriately managed to meet resource objectives, then they could mitigate the effects of some of the constraints; some of the challenges associated with using this management tool are described below.

Although wildfires managed for resource objectives are not explicitly prohibited under alternative A, management direction provided by the 1987 plan makes it extremely difficult to implement wildfire treatment in the wilderness. Some examples of these constraints include maximum size limits (of 300 acres or less for seven of eight wilderness areas), a requirement to be able to contain a fire by 10:00 a.m. the following day, and pre-treating with prescribed fires prior to wildfires in areas of "unnatural fuel buildups" (1987 Plan, pages 111-112). These constraints have resulted in no wildfires managed to meet resource objectives in wilderness areas on the forest since the current forest plan was signed (1987). Wildfires that occur in designated wilderness areas would generally have a greater risk of resulting in uncharacteristic fire effects, including having higher than desired fire severity, or larger than desired high-severity patches, and a decreased likelihood of restoring the historic fire regime and vegetation structure. Based on these constraints and the current trend in treatment within wilderness, it is expected that designated wilderness areas would trend away from desired vegetation conditions and the ERUs overall would make somewhat slower progress toward desired conditions.

Alternative B (modified)

Under alternative B (modified), three new wilderness areas are proposed for designation. Abineau, Strawberry Crater, and Davey's recommended wilderness areas total approximately 8,733 acres and occur across eight ERUs. The majority of the proposed areas fall within the Pinyon Juniper with Grass and Great Basin Grassland ERUs (all within the Strawberry Crater Recommended Wilderness); however, the proposed areas also represent only a relatively small fraction of each ERU (1.4 percent and 2.5 percent, respectively). The effects of the recommended wilderness designation on specific vegetation and fire return interval departure is addressed within the Environmental Consequences section for each ecological response unit.

The direction under alternative B (modified) promotes the maintenance or enhancement of the primitive and undeveloped characteristics in recommended wilderness and supports reduced evidence of modern human control or manipulation (SA-RWild-DC 1,2), thus, fire could be an appropriate tool. Once recommended wilderness areas are designated, plan components encourage disturbances, including fire and flooding, to play their natural role as a disturbance agent within

wilderness areas (SA-Wild-DC-4). Other plan components promote wildland fires within historic fire regimes with the caveat that they do not result in the loss of life, property, or ecosystem function (FW-Fire-DC 2,3); encourage the restoration of desired disturbance regimes, including fire, when practical (FW-TerrERU-All-DC-2) and encourage fire management activities where conditions permit and where consistent with maintenance of or moving toward desired conditions for other resources (FW-Fire-G-2, Management Approaches for Fire Management) without the additional constraints found under alternative A. Consequently, despite the remaining constraints, there would be more opportunities to treat fire-adapted ERUs with fire, compared to alternative A.

On the other hand, plan language for recommended wilderness constrains the use of motorized equipment (SA-RWild-DC 1, 2) which is an important mitigation for some safety risks and in some areas would be important for pre-treatment to reduce the risk of greater than desired fire severity. However, the overall affected area is limited and represents a small fraction of each ERU (table 15).

The effect of the recommended wilderness areas to ERUs that are suitable for producing timber (ponderosa pine and mixed conifer with frequent fire) is negligible (less than 1 percent of the suitable timber within each ERU). Where there would be an effect, it is expected to be small, relatively localized, and specific to Abineau and Strawberry Crater RWAs.

Alternative C

Under alternative C, 10 additional new wilderness areas are proposed for designation beyond those under alternative B (modified). Barbershop, Black Mountain, Cedar Bench, Cimarron-Boulder, Deadwood Draw, East Clear Creek, Hackberry, Railroad Draw, Tin Can, and Walker Mountain add to the previous recommended wilderness areas totaling approximately 90,853 acres and occur across 15 ERUs. The majority of the proposed area falls within the Pinyon Juniper Evergreen Shrub, Pinyon Juniper Woodland and Semi-desert Grassland ERUs. The proposed areas represent anywhere between less than 0.1 percent to 19 percent of the ERUs (table 15).

The effect to suitable timberlands is relatively minor. Approximately 94 percent of acres affected by the recommended wilderness areas are within vegetation types that are designated as incapable of producing industrial wood. Approximately 5 percent of the remaining proposed area is designated as unsuitable timberlands (with timber component codes associated with old growth and Mexican spotted owl PACs – see timber suitability discussion below). This leaves only approximately 1 percent of the area restricting what is currently designated as suitable for timber production. The difference between alternative C and alternative B (modified) is not large enough to impact modeling results. So, the outcome is expected to be the same as under alternative B (modified) with regard to vegetation departure in lands capable of producing timber and recommendation of wilderness in alternative C would not have a major effect on vegetation management.

Of the areas that are designated as incapable of producing industrial wood, the greatest effect is expected to occur in the Pinyon Juniper Evergreen Shrub, Pinyon Juniper Woodland, and Semi-desert Grassland ERUs. In these ERUs, the recommended wilderness areas represent larger proportions of the total ERU area. For example, within the Pinyon Juniper Evergreen Shrub ERU, the conversion of over 50,000 acres into wilderness would represent approximately 19 percent of the total ERU. When combined with the portion of the ERU that is already designated as wilderness, the affected area represents nearly 40 percent of the total ERU. That is a substantial portion of a fire-adapted ERU that may be constrained with regard to mechanical treatments and fire management. The effects of the recommended wilderness designation on vegetation and fire return interval departure is specifically addressed within each ERU section.

Alternative C is similar to alternative B (modified) in terms of allowing fire to play its natural role as a disturbance agent within wilderness areas (SA-Wild-DC-4) and allowing fire management without the additional constraints included under alternative A. Like alternative B (modified), recommendation of wilderness could increase coordination needs, logistical complexity (mainly access), and reduce the available fire management tools (chainsaws, all-terrain vehicles (ATVs), fire engines, etc.) which in some areas would be important to mitigate some risks to firefighters and for pre-treatment to reduce the likelihood of greater than desired fire severity The substantial increase in areas recommended for wilderness designation under this alternative would lead to fewer opportunities to use prescribed fire and wildfires managed for resource objectives than under alternative B (modified). The total amount of recommended wilderness area is about 10 times that of alternative B (modified). This represents a small fraction of most ERUs except for Semi-desert Grassland, Pinyon Juniper Evergreen Shrub, and Pinyon Juniper Woodland in which between 13 to 19 percent of these individual ERUs are affected (table 15). The majority of these ERU acres are in the following recommended wilderness areas: Black Mountain, Cedar Bench, Cimarron-Boulder, Deadwood Draw, Hackberry, Tin Can, and Walker Mountain.

Alternative D

Alternative D is similar to alternative A in that there are no wilderness areas recommended for designation. Unlike alternative A, but like alternatives B (modified) and C, alternative D would not have the plan language that adds additional constraints to the use of wildfire managed for resource objectives. As a result, under this alternative there would be more opportunities to manage wildfires and prescribed fires to meet resource objectives than under any other alternative.

Table 19. Existing and recommended wilderness areas within each ERU and riparian areas under the action alternatives

ERU and Riparian Areas	Total Forest Acreage	Designated Wilderness Acres	Percent of Total ERU	Alternative B (modified) Acres	Percent of Total ERU	Alternative C Acres	Percent of Total ERU
Desert Communities	62,877	878	1.4%			949	1.5%
Semi-desert Grassland	89,701	3,640	4.1%	132	0.1%	12,041	13.4%
Great Basin Grassland	92,842	190	0.2%	2,327	2.5%	2,327	2.5%
Montane/Subalpine Grassland	23,656	628	2.7%			6	0.0%
Interior Chaparral	50,471	39,065	77.4%			1,720	3.4%
Pinyon Juniper with Grass	261,454	4,184	1.6%	3,618	1.4%	3,618	1.4%
Pinyon Juniper Evergreen Shrub	263,554	47,893	18.2%	723	0.3%	50,164	19.0%
Pinyon Juniper Woodland (Persistent)	75,439	5,200	6.9%	1,467	1.9%	13,600	18.0%
Ponderosa Pine	797,171	31,086	3.9%	97	0.0%	4,462	0.6%
Mixed Conifer with Frequent Fire	49,595	778	1.6%			283	0.6%
Mixed Conifer with Infrequent Fire	37,143	8,193	22.1%	347	0.9%	347	0.9%
Spruce Fir Forest	13,946	11,245	80.6%				
Alpine Tundra	939	898	95.6%				
*Cottonwood Willow Riparian Forest	1,324	113	8.5%			233	17.6%
*Mixed Broadleaf Deciduous Riparian Forest	5,926	2,073	35.0%	21	0.4%	662	11.2%
*Montane Willow Riparian Forest	3,568	451	12.6%			438	12.3%
*Wetland/Cienega	10,121	1	0.0%			3	0.0%
	**1,839,927	156,532		8,732		90,853	

* See more detailed discussion of these riparian areas in the Riparian Specialist Report (USDA Forest Service 2016b).

**This table does not include areas classified as Urban/Agricultural or water.

Special Areas and the Recreation Opportunity Spectrum

Special Areas include a variety of specially designated areas within the forest including Wilderness (discussed above), Research Natural Areas, Botanical Areas, Geological Areas, Wild and Scenic Rivers, and Inventoried Roadless Areas. Each designation contains management constraints that promote and protect the essential characteristics of the area.

The recreation opportunity spectrum (ROS) is a framework for stratifying and defining classes of outdoor recreation environments, activities, and experience opportunities. Some management activities are restricted under certain ROS classes. In areas that have been specially designated or where the more restrictive ROS classes have been assigned, departure relative to the desired conditions for vegetation and fire return interval may be affected.

Alternative A

Under this alternative, there are three designated research natural areas: Oak Creek RNA in the West Fork of Oak Creek and Red Rock-Secret Mountain Wilderness, Casner RNA to the north of Schnebly Hill Road, and San Francisco Peaks in the Kachina Peaks Wilderness. There are three proposed research natural areas: an east and a west extension to the existing San Francisco Peaks RNA in the Kachina Peaks Wilderness, West Clear Creek RNA in the West Clear Creek Wilderness, and Rocky Gulch RNA. There are four botanical areas: Verde Valley, Mogollon Rim, Fossil Springs, Fern Mountain. Red Mountain is the only geological area.

The 1987 Plan prohibits timber harvest and firewood cutting in research natural areas, botanical areas, and geological areas (1987 Plan, page 195); however, it does not explicitly prohibit fire treatments. Under Alternative A, prescribed fires are allowed provided that they are appropriate and compatible with the management objectives of the specific area (1987 Plan, pages 65-3, 195-196). However, this alternative's silence on the use of wildfires managed to meet resource objectives within special areas is ambiguous and has been interpreted as a prohibition of this type of fire management. Consequently, it has resulted in no treatment based on using wildfires in these areas since the 1987 Plan was signed and amended (1987 through 1998).

In the Oak Creek RNA and Casner RNA, Alternative A allows ecosystem processes such as fire and flood to play natural role and prohibits recreation fires while management is consistent with preservation for research values (1987 Plan, page 196-1).

In general, plan direction results in increased treatment complexity because of the overlap with wilderness, high recreation use, the proximity of buildings or other infrastructure, and the presence of endangered or rare plants or non-fire-adapted vegetation types. Thus, in general, fire treatments would be less likely to occur.

The three proposed RNAs were originally proposed under the 1987Plan, but they were never designated. The West Clear Creek RNA (769 acres) and the San Francisco Peaks RNA expansion areas (285 acres) are both within established wilderness areas, so they would not add any additional constraints to timber management beyond those that are already in place. The Rocky Gulch RNA is approximately 926 acres and falls within the Ponderosa Pine ERU. This represents a very small fraction of the total ERU, and as such, would have small and highly localized impacts restricted to this RNA. Within this small area, plan direction allows the use of prescribed fire, but could limit opportunities for the use of wildfire managed to meet resource objectives and would prohibit mechanical treatments. Overall, this would have a negligible impact to vegetation and fire return interval departure and trend for ponderosa pine.

Alternative A allows prescribed fire where appropriate in wild and scenic rivers (1987 Plan, page 65-3) although it lacks direction for eligible wild and scenic rivers in contrast to the other alternatives.

Alternative A is silent on inventoried roadless areas (IRAs) whereas the other alternatives have plan direction specific to IRAs. The forest follows national policy (36 CFR Part 294, 2001 Roadless Area Conservation) under all alternatives. National policy prohibits timber cutting, sale, or removal except as specified in section 294.13 (including but not restricted to small-diameter timber, improvement to threatened, endangered, or sensitive species habitat, maintenance or restoration of ecosystem composition and structure such as to reduce the risk of uncharacteristic fire effects).

Under the 1987 Plan, there is no direction that directly addresses the use of prescribed fire and wildfires managed to meet resource objectives within the various ROS classes. The ambiguity that this creates has resulted in a reluctance to conduct any fire treatments in semi-primitive non-motorized areas. It is expected that this would continue to be the case in the future and result in relatively fewer opportunities to conduct restoration treatments within semi-primitive non-motorized areas using fire. Consequently, there would be a greater risk of uncharacteristic fire, higher than desired fire severity, and less progress toward the desired condition for vegetative structure and fire return intervals in these areas.

Alternative B (modified)

Under this alternative, the Rocky Gulch RNA, West Clear Creek RNA, and the eastern expansion of the San Francisco Peaks RNA are carried forward. However, the size of the proposed expansion to the San Francisco Peak RNA has been reduced and the location of the West Clear Creek RNA has been changed to better meet the intent for its selection. The West Clear Creek RNA (1,007 acres) and the San Francisco Peaks RNA expansion area (141 acres) are both still within established wilderness areas, so they would not add any additional constraints to management beyond those that are already in place. The Rocky Gulch RNA remains the same as under alternative A. Beyond the proposed RNAs, there is also the proposed Cottonwood Basin Geological and Botanical Area (1,850 acres).

Established and proposed research natural areas, geological areas, and botanical areas can be managed with prescribed fire and wildfires managed to meet resource objectives provided that they protect and maintain the unique characteristics of the area (SA-RNABotGeo-DC-5, G-1). In addition, minimal impact suppression tactics should protect the resources for which these areas were designated or proposed (SA-RNABotGeo-G-3). The potential for human-caused wildfires would be reduced because overnight camping and recreation campfires are prohibited in established RNAs (SA-RNABotGeo-S-1). Activities in botanical and geological areas should not have negative impacts to physical or biological processes (SA-RNABotGeo-DC-5) and in established and proposed research natural areas, fire management activities should mimic natural processes (SA-RNABotGeo-G-2).

As described under alternative A, there would be increased treatment complexity within established and proposed research natural areas, botanical areas, and geological areas. The use of fire treatments in existing and proposed RNAs and designated botanical and geological areas are supported by plan direction which encourage the maintenance of natural condition and processes (SA-RNABotGeo-DC-1, 2, 5). Fire should be managed using minimal management suppression tactics or other tactics to protect the resources for which research natural areas, botanical areas and geological areas were designated, established, or proposed (SA-RNABotGeo-G-3). If there is ongoing research within established and proposed RNAs, fire treatments should be compatible (SA-RNABotGeo-G-2). Where research and wildfires managed to meet resource objectives intersect, implementation is more complex due to emergency timeframes. In the past, this complexity has resulted in a suppression or avoidance approach. Opportunities to use this kind of fire treatment in these areas may be missed

again as a result of this complexity and site-specific conditions. Consequently, where fire treatments are applied, the area would move toward the desired condition. In areas where fire treatments are not implemented, there may be localized departures from the desired conditions for vegetation and fire return interval.

Under alternative B (modified), a number of areas that were previously designated as “roaded natural” under the ROS have been reclassified as “primitive.” These areas allow mechanized access, but not motorized access (except for game retrieval). Primitive areas primarily represent recommended wilderness. Besides recommended wilderness, there two other cases where areas are classified as “primitive.” The first is an area representing approximately 324 acres and is located at the bottom of Walnut Canyon. This area is managed by the Coconino NF, but coordination occurs with the National Park Service which manages the surrounding Walnut Canyon National Monument. The second is an area of approximately 5,041 acres that represent portions of designated wilderness that fall within the Coconino NF administrative boundary but are managed by neighboring national forests (i.e., the Mazatzal Wilderness managed by the Tonto National Forest and the Kendrick Mountain Wilderness managed by the Kaibab National Forest). Any areas within designated wilderness are subject to all laws, regulations, and policies related to wilderness, regardless of the ROS classification. The consequences of both recommended wilderness and designated wilderness areas are discussed in detail in this report under the Wilderness section of Environmental Consequences.

Some other areas that were previously classified as “roaded natural” were reclassified as “semi-primitive non-motorized.” Under alternative B (modified), the reclassification of some areas as semi-primitive non-motorized is paired with an explicit recognition that prescribed fire and wildfires may be managed to meet resource objectives in all ROS classes, including primitive areas (see Fire Management-Management Approaches). As a consequence, it is expected that there would be more opportunities for restoration under alternative B (modified) than under alternative A, and as such, there would be greater progress toward the desired conditions.

There is no explicit language in alternative B (modified) regarding vegetative management or fire management in relationship to designated and eligible wild and scenic rivers. However, designated and eligible wild and scenic river segments would be managed to retain their free-flowing condition and their outstandingly remarkable values (i.e., archaeological, scenic, fishery, wildlife, recreational, and botanical). Eligible classifications remain intact until further study is conducted or designation by Congress (SA-WSR-DC-1). Vegetation and fire would be managed to meet these desired conditions.

Projects and activities conducted under alternative B (modified) would maintain the overall roadless character of inventoried roadless areas (SA-IRA-DC-1, S-1), similar to alternative A. Although alternative A lacks this language in the current plan, the overall effect is the same because this is national policy.

Alternative C

Under this alternative, the Rocky Gulch RNA, West Clear Creek RNA, and San Francisco Peaks RNA expansion are the same as those proposed under alternative B (modified). The proposed Cottonwood Basin Geological and Botanical Area is also the same as under alternative B (modified).

Under alternative C, a number of areas that were previously designated as “roaded natural” under the ROS have been reclassified as “primitive.” These areas allow mechanized access (e.g., bicycles), but not motorized access (except for game retrieval). Primitive areas primarily represent recommended wilderness and there are far more recommended wilderness areas in this alternative than under

alternative B (modified). The other areas besides recommended wilderness, that have been classified as “primitive” are the same as under alternative B (modified).

Some other areas that were previously classified as “roaded natural” were reclassified as “semi-primitive non-motorized.” Under alternative C, the reclassification of some areas as semi-primitive non-motorized is again paired with an explicit recognition that prescribed fire and wildfires may be managed to meet resource objectives in all ROS classes, including primitive areas (see Fire Management-Management Approaches). As a consequence of this clarifying statement, it is expected that there would be more opportunities for restoration (and greater progress toward desired conditions) under alternative C than under alternative A and generally the same as under alternative B (modified).

Alternative C would be similar to alternative B (modified) for designated and eligible wild and scenic rivers and for inventoried roadless areas.

Alternative D

Alternative D differs from alternative B (modified) in that an area representing only 217 acres is proposed for the Cottonwood Basin Geological Area. There is no botanical area proposed under this alternative. Otherwise, the proposed RNAs are the same. No wilderness areas are recommended under this alternative, so there are fewer acres classified as “primitive.” The only primitive areas are those portions of designated wilderness managed by neighboring forests and the canyon bottom of Walnut Canyon (see the discussion under alternative B (modified)).

Alternative D has the greatest number of acres classified as “semi-primitive non-motorized”; however, the management direction and management approaches for the use of fire are the same as under alternative B (modified). Therefore, with regard to these areas, the effects are expected to be generally the same as under alternative B (modified). Alternative D also would have similar effects as alternative B (modified) for designated and eligible wild and scenic rivers and inventoried roadless areas.

Forestwide Threat of Uncharacteristic Fire

Based on the established range of objectives (or treatment assumptions under alternative A), it is expected that the risk of uncharacteristic fire would be reduced in ERUs that have treatment objectives (table 20). When there are a range of objectives for an ERU, the number of acres on which there is a reduction in the risk of uncharacteristic fire varies. The affected acres are based on objectives for mechanical treatment, treatment with prescribed fire, and wildfires managed fore resource objectives. Both mechanical treatments and prescribed fire treatments, alone or in combination, will reduce the risk or uncharacteristic fire. It is assumed that whenever an area is mechanically treated, it will also be treated with prescribed fire (though in some cases it may occur in the subsequent 10-year analysis period). Some areas, however, may be treated with prescribed fire or with wildfires managed for resource objectives alone.

Multiple ERUs also have objectives to treat a proportion of the area with naturally ignited wildfires to meet resource objectives. However, since it is not possible to predict the location or extent of wildfires, the impact cannot be anticipated in advance. If wildfires are managed for resource objectives in areas where neither mechanical nor prescribed fire treatments have recently occurred, then the total acres where there is a reduction in the risk of uncharacteristic fire would increase commensurately. However, if wildfires are managed for resource objectives in areas where mechanical or prescribed fire treatments have already occurred, then the reduction in the risk of uncharacteristic fire would simply be maintained or improved, but the total acres would not increase.

Table 20 displays the acres of each ERU where the risk of uncharacteristic fire would be reduced based on mechanical and prescribed fire treatments.

Table 20. Acres by ERU on which uncharacteristic fire would be reduced for each alternative

ERU*	Alternative A		Alternatives B (modified), C, and D	
	Low Objective	High Objective	Low Objective	High Objective
Semi-desert grassland	N/A	N/A	N/A	3,500
Great Basin Grassland	N/A	7,000	10,800	12,400
Montane/Subalpine Grassland	N/A	N/A	7,600	11,400
Pinyon-Juniper with Grass	N/A	1,000	1,000	10,000
Ponderosa pine	150,000	260,000	150,000	260,000
Mixed Conifer with Frequent Fire	N/A	8,000	8,000	15,000

* Only those ERUs with specific treatment objectives are included.

Wildland-urban Interface

Common to All Alternatives

All alternatives provide direction for fuels reduction treatments and maintenance of vegetation for those areas of resident populations at imminent risk from wildfire, as well as human developments having special significance, such as infrastructure. These wildland-urban interface areas encompass not only the sites themselves, but also the continuous slopes and fuels that lead directly to the sites, regardless of the distance involved. Overall, trends for vegetation as it relates to fire and fire severity would improve under all alternatives in Ponderosa Pine and Mixed Conifer with Frequent Fire ERUs. A trend toward desired conditions means the ecological system is moving toward characteristic fire, including a reduction in severity and a reduction in the risk of uncharacteristic fire.

Alternative A

Alternative A presents the least opportunity for implementing treatments, mainly due to management constraints on wildfires managed to meet resource objectives and a general lack of plan emphasis on the ecological need for frequent fire in fire-adapted ecosystems. Alternative A explicitly prohibits the use of wildfires to meet resource objectives in the wildland-urban interface and Oak Creek Canyon (1987 Plan, page 92) and limits its use in wilderness. While the assumption is that within the Ponderosa Pine ERU, mechanical treatment levels will be the same as under the action alternatives, this prohibition still has the potential to negatively affect restoration efforts by reducing our ability to use wildfires to meet resource objectives in the wildland-urban interface. For the remaining ERUs, there are either no treatment objectives or an assumption that fewer acres would be mechanically treated under alternative A than under the action alternatives. As a result, it is expected that fewer acres would be treated within wildland-urban interface, and therefore, there would be a higher likelihood that the vegetation within wildland-urban interface would have greater tree density and would experience higher fire severity than is desired. Furthermore, if a wildfire moved into the area surrounding communities under severe fire weather conditions, it could be more difficult to suppress, would require more resources, may increase the risk to firefighters, and could put people, property, and infrastructure at greater risk.

Alternative B (modified)

Alternative B (modified) would result in more acreage treated by wildfires managed for resource objectives and higher fire intensities in the wildland-urban interface compared to alternative A. Given that frequent fire decreases fire behavior (and resultant severity), this alternative would provide for more opportunities for fire treatments, which would lead to less undesirable fire behavior.

Alternative B (modified) makes managing wildfires for resource objectives more probable (forestwide) by having clear objectives that are consistent with fire treatment (FW-TerrERU-PP-O-3, FW-TerrERU-PJ-O-2, 3). This alternative also clearly articulates the need to create and maintain the most resilient and least volatile forest composition and structure within the wildland-urban interface (FW-WUI-DC-2, 3, 4, 5, 6, 7, 8, 9). This more resilient condition would take the form of relatively open stands with lower tree densities and fuel loads but still be within desired conditions (FW-WUI-G-1). Furthermore, this alternative has guidelines (FW-Fire-G-1 and FW-Fire-G-2) that emphasize fire treatment in the wildland-urban interface and encourage the use of fire to move ERUs toward desired conditions. In addition, there are forestwide management approaches that emphasize fire treatment planning and implementation (Fire Management – Management Approaches). In contrast, alternative A lacks substantial emphasis on the natural role of fire in restoring and maintaining the composition, structure, and function of fire-adapted ERUs.

As discussed under the environmental consequences sections for wilderness and wildland-urban interface, the recommendation of new wilderness areas and their juxtaposition relative to communities and infrastructure creates complexities and uncertainties that could decrease the likelihood of managing wildfires for resource objectives even though fire treatments are encouraged in wildland-urban interface and wilderness (FW-Fire-G-1 and G-2). The three recommended wilderness areas under alternative B (modified) could contribute to these complexities. Consequently, there may be fewer opportunities to use this restoration tool around communities. It is expected that alternative B (modified) would reduce the threat to communities more than alternative A due to plan language that supports the use of wildfire managed for resource objectives in wildland-urban interface, wilderness, and Oak Creek Canyon paving the way more frequent fire treatments. Ultimately, the amount of threat reduction depends on the frequency of treatments, the location of the wildfire (relative to the community or specially designated areas), the size of the treated areas, and the effectiveness/level of treatment (how much these treatments reduce vegetation, modify the fuels profile, and reduce volatility).

When wildland-urban interface intersects ERUs with a mixed or high-severity fire regime, such as Interior Chaparral, Pinyon Juniper Evergreen Shrub, Pinyon Juniper Woodland, Mixed Conifer with Infrequent Fire, Spruce-Fir ERUs and some portions of Mixed Conifer with Frequent Fire ERU, characteristic ecosystem function is modified to promote low-severity surface fires (FW-WUI-DC-8). This plan direction is a trade-off between the departure from characteristic fire regimes and the potential impact on communities and other at-risk values. The trends for all of these ERUs (with the exception of Mixed Conifer with Frequent Fire and Spruce Fir) are away from desired conditions in terms of fire return interval. The Pinyon Juniper Evergreen Shrub and Mixed Conifer with Infrequent Fire ERUs are adapted to mixed-severity in which 25 to 75 percent of the dominant overstory is replaced. Interior Chaparral, Pinyon Juniper Woodland, and Spruce Fir ERUs are adapted to high-severity fires in which over 75 percent overstory replacement is within the natural range of variability.

The consequences of this direction (FW-WUI-DC-8) are complex. If wildfires occur within the wildland-urban interface portions of these mixed- and high-severity fire ERUs and conditions are not

conducive to low-severity fires, then the likelihood of a suppression response increases. Mechanical or prescribed fire pretreatment would be a critical management strategy to promote the desired condition. If pre-treatment is accomplished and conditions are suitable, progress would be made toward the desired conditions even if the ERUs are departing from the natural fire regime. In the absence of mechanical or prescribed fire pretreatment, this pattern of suppression may have the effect of increasing the fire intensity and severity of future fires within wildland-urban interface into the higher range of (or beyond) the natural fire regime. Within wildland-urban interface, it may continue to move the ERU away from desired conditions and, for mixed-severity ERUs, away from historic conditions as well. While this direction could have effects within wildland-urban interface, is not expected to affect treatment frequency or fire return interval departure across the ERUs as a whole.

Plan alternatives primarily affect the threat to community in terms of how each alternative provides opportunities for treatment. As the number of opportunities for treatment increases, the chances that a treatment would occur also increase and the potential threat of uncharacteristic fire to communities decreases. This threat has been assessed, independent of ERU, because most vegetation types are susceptible to fire and can threaten communities and infrastructure values.

Alternative C

Alternative C is similar to alternative B (modified) in that it has the same clear desired conditions, objectives, and also presents more opportunities for treatment than alternative A by not prohibiting the use of wildfires managed to meet resource objectives in the wildland-urban interface. However, it also proposes to include a substantially greater number of acres as recommended wilderness than in alternative B (modified). As discussed above, the proximity of the recommended wilderness areas to wildland-urban interface and the constraints associated with operating within and around wilderness can reduce the likelihood of managing wildfires for resource objectives within the wildland-urban interface. Generally, the threats to communities would be slightly higher because these constraints affect a larger area.

Alternative D

Alternative D is not expected to differ substantially from alternative B (modified). It has the same clear desired conditions, objectives, and presents more opportunities than alternative A for treatment by not prohibiting the use of wildfires managed for resource objectives in the wildland-urban interface. However, no new wilderness areas are recommended under this alternative, so there would be less area than under alternative B (modified) constrained by management direction related to wilderness. Generally, this alternative would provide the greatest opportunity for fire treatment and as such, would result in the least threat of uncharacteristic fire to communities.

Old Growth

Alternative A

Under alternative A, direction for old growth is highly prescriptive with direction to allocate at least 20 percent of each forest type within a 10,000-acre block to old growth based on minimum structural attributes. In some ERUs, old growth is also prescribed for particular areas. This approach would not help meet the regionally consistent desired conditions for a number of ERUs (FW-TerrERU-PJ-DC-2, 5, 7, 10, 11, 12; FW-TerrERU-PP-DC-6, 9, 13; FW-TerrERU-MC-MCFF-DC-2, 4, 7, 9, 10, 11; FW-TerrERU-MC-MCIF-DC-1, 2, 4, 9; FW-TerrERU-SF-DC-1, 2, 3, 9). It would also put old growth at a greater risk of loss than under historic conditions because the emphasis is on larger continuous areas with higher basal area and canopy cover, a structure that is highly susceptible to active crown fire, rather than on having old-growth components present throughout the landscape.

In Ponderosa Pine and in Mixed Conifer ERUs, the emphasis is placed on creating and maintaining large stands (100 to 300 acres) or large aggregations of contiguous stands that all have the full suite of old growth characteristics (1987 Plan, pages 70-2; 129; 138). By maintaining old growth conditions as they are described in the structural attributes table (1987 Plan, page 70-2) across 20 percent of each forest/woodland ERU (1987 Plan, page 70-1), the desired distribution of closed canopy, medium to very large tree states as modeled over the analysis period (see the ERU discussions below) would be largely the same under all alternatives for the Ponderosa Pine ERU (table 23); however, the spatial arrangement of these stands under Alternative A would be different than the desired conditions (FW-TerrERU-PP-DC-6, -9). For the mixed conifer with frequent fire ERU, alternative A would result in less progress toward desired conditions than under alternative B (modified). Specifically, less progress would be made in reducing the amount of closed canopy, medium to very large tree states across the landscape (table 28 and table 30) and the spatial arrangement of these stands would not meet the desired conditions (FW-TerrERU-MC-MCFF-DC-2, -7).

The direction under alternative A would tend toward larger areas with a more closed canopy and a more even-age structure than historic conditions and the desired conditions. This structure is not supported by the best available science that is specific to the Southwest (Reynolds et al. 2013). The best available science indicates that, in these ERUs, old growth components (e.g., old trees, snags, large logs) should be scattered throughout the landscape, including old tree groups or single old trees intermixed with other age classes. Occasionally, old growth may also occur as a small even-aged patch of trees. Openings of variable sizes also occur between irregularly sized and shaped groups and patches of trees. In the long term, the desired distribution could never be achieved under alternative A because the 20-percent target is fundamentally incompatible with the desired conditions. Instead, closed canopy, medium to very large tree states would be consistently overrepresented; the open canopy, medium to very large tree states that were more common under historic conditions and which should dominate under the desired conditions would be consistently underrepresented.

Under alternative A, both the Pinyon Juniper Grasslands and Pinyon Juniper Evergreen Shrub ERU have direction that emphasizes large old-growth stands (100 to 300 acres) and limits mechanical treatment to gentler slopes while providing for old growth on steeper slopes (1987 Plan, page 148). Concentrating the old growth in unnaturally large areas on steeper slopes rather than encouraging old-growth components in small areas throughout the ERU does not meet the desired conditions (FW-TerrERU-PJ-DC). Furthermore, by limiting mechanical treatments to areas with slopes less than 15 percent, the development of old-growth components would be on a slower trajectory than could otherwise be achieved if mechanical treatment could occur throughout the ERU.

Unlike in the preceding ERUs, large old-growth stands (100 to 300 acres) in Pinyon Juniper Woodland would meet the desired conditions; however, the emphasis under alternative A to provide for old growth primarily on steeper slopes and limiting mechanical treatments to areas with slopes less than 15 percent would put the development of old-growth components on a slower trajectory than could otherwise be achieved if old-growth components were emphasized throughout the ERU.

In other ERUs where fire disturbances are less frequent, such as Mixed Conifer with Infrequent Fire and Spruce Fir, the desired conditions are compatible with large old-growth stands proposed under alternative A. Under the historic fire regime, disturbances from fire are less frequent and tend toward either mixed or high severity. However, barring a major disturbance, the old-growth characteristics within these ERUs are expected to increase over time.

Plan language providing direction on the size, distribution, and frequency of snags is discussed specifically under each ERU. The expected number and sizes of snags under the different alternatives is also discussed.

Alternative B (modified)

Under alternative B (modified), Ponderosa Pine, Mixed Conifer with Frequent Fire, Mixed Conifer with Infrequent Fire, Pinyon Juniper Grassland, Pinyon Juniper Evergreen Shrub, Pinyon Juniper Woodland, and Spruce Fir ERUs all have desired conditions that describe the appropriate distribution of old-growth components relative to the reference and desired conditions (FW-TerrERU-PJ-DC-2, 5, 7, 10, 11, 12; FW-TerrERU-PP-DC-5, 6, 9, 13; FW-TerrERU-MC-MCFF-DC-2, 4, 7, 9, 10, 11; FW-TerrERU-MC-MCIF-DC-1, 2, 4, 9; FW-TerrERU-SF-DC-1, 2, 3, 9). In ERUs that experience more frequent fire disturbances, old-growth components are expected to be present throughout the landscape as individuals, as part of small multi-aged groups, and occasionally, in small even-aged groups. This structure and distribution is not only supported by the best available science (Reynolds et al. 2013), but also provides greater protection from losses due to disturbances (e.g., insect, disease and uncharacteristic wildfire) than would be provided under alternative A.

Unlike under alternative A, under this alternative there are treatment objectives for several ERUs and guidelines that specifically address the retention, protection, and promotion of old-growth components. Particular attention is given to identifying and retaining pre-settlement ponderosa pine (FW-TerrERU-PP-G-3), which contribute to characteristic old growth conditions throughout the forest. Other important components of old growth are also specifically highlighted such as large Gambel oak trees and snags (FW-TerrERU-PP-G-4; FW-TerrERU-MC-All-DC-3) and large snags and logs (FW-TerrERU-PP-G-5; FW-TerrERU-MC-All-DC-2). Furthermore, there is the recognition that the location of old-growth components shifts across the landscape over time and there is a need to provide replacement structural stages to assure continuous representation of old growth (FW-TerrERU-PJ-DC-2; FW-TerrERU-MC-MCIF-DC-2; FW-TerrERU-PJ-G-5; FW-TerrERU-MC-MCFF-DC-2; FW-TerrERU-MC-All-G-2, -3; FW-TerrERU-PP-DC-6; FW-TerrERU-PP-G-1, 2, 3, 4, 5). Within the three Pinyon Juniper ERUs, the rate at which old-growth components develop would be faster under alternative B (modified) than under alternative A because mechanical treatments are not limited on steeper slopes and old growth is promoted across the entire landscape.

In ERUs that experience less frequent fire disturbances, there is less difference in the effects between alternative A and alternative B (modified). Both recognize that old-growth component aggregations are typically larger than in frequent fire ERUs, but the desired conditions under alternative B (modified) explicitly describe how the aggregations vary in space and time (e.g., FW-TerrERU-SF-DC-2 and FW-TerrERU-MC-MCIF-DC-2).

Alternative C

With respect to old growth, alternative C differs from alternative B (modified) in that it also incorporates all of the direction (with some minor adjustments) associated with old growth from the 1987 Plan (alternative A). In effect, there is guidance to retain, protect, and promote old growth and desired conditions that emphasize the presence of old-growth components across the landscape, but there is also guidance to maintain old-growth stands of 100 to 300 acres and to allocate at least 20 percent of each forest or woodland ERU within any 6th code watershed to old growth, based on minimum structural attributes.

As discussed under alternatives A and B (modified), old-growth stands of 100 to 300 acres are ecologically inappropriate for ERUs that evolved with frequent fire (Ponderosa Pine, Mixed Conifer with Frequent Fire, Pinyon Juniper Grassland, and Pinyon Juniper Evergreen Shrub); this pattern and structure would fail to meet the desired conditions that are described as having old-growth

components distributed throughout the landscape rather than heavily aggregated within large blocks. Large areas of old growth are a characteristic of fire regimes that experience less frequent and more severe fires (such as those found in Mixed Conifer with Infrequent Fire and Spruce Fir).

The direction under alternative C would encourage departure from the desired conditions in fire-adapted ERUs by maintaining a larger proportion of the ERU as even-aged stands. These large blocks would be at a greater risk of loss to disease and uncharacteristic wildfire because they would generally be composed of similar-sized trees and would have more closed continuous canopies. In these areas, understory vegetation and other shade-intolerant species such as Gambel oak and aspen would also be suppressed due to limited sunlight. By both maintaining old-growth conditions as they are described in the current plan's structural attributes table (1987 Plan, page 70-2) across 20 percent of each forest/woodland ERU and also promoting old-growth components across the landscape, the desired distribution of closed canopy, medium to very large tree states (see the specific ERU discussions below) could never be achieved. Instead, this tree state would be consistently overrepresented. The open canopy, medium to very large tree states that were more common under historic conditions and are more common under desired conditions would be consistently underrepresented.

Alternative D

Alternative D does not differ from alternative B (modified) with respect to old growth. The outcome is expected to be the same.

Climate Change

Alternative A

The environmental consequences of plan language related to climate change and forest health in alternative A are similar to alternatives B (modified), C, and D. The effects of climate change to some ERUs are expected to be similar across all alternatives; however, within ERUs that have treatment objectives, the magnitude of the risks and the potential effects of climate change are sometimes greater under alternative A

For example, in the Alpine Tundra ERU, the risk is generally the same under all alternatives. The plants within this ERU are not fire-adapted, but neither are they particularly at risk of uncharacteristic wildfires. On the other hand, as temperatures increase and precipitation decreases, these plants could become stressed and experience a higher rate of mortality. Furthermore, as this ERU already occurs at the highest elevations found on the Coconino NF, there are no opportunities for these species to migrate upward in elevation to find more suitable conditions. These potential outcomes are associated with the risks of climate change, but none of the various alternatives under consideration would have a particularly mitigating effect. Similarly, the Spruce-Fir ERU is found at high elevations and is moisture-dependent. If warmer and drier conditions persist, the dominant tree species could become stressed and highly susceptible to insects and disease. Drier conditions could also support wildfires at more frequent intervals than were present historically. The ensuing mortality could result in dramatic shifts in composition and structure. There are very limited opportunities for these species to migrate upward in elevation to find suitable growing conditions. Consequently, there is the potential that the ERU could disappear from the forest entirely. Again, none of the alternatives proposes treatments or other plan language that would improve the resilience of this ERU to climate change, so the anticipated effects are the same.

On the other hand, within ERUs such as Ponderosa Pine, Mixed Conifer with Frequent Fire, and Pinyon Juniper with Grass, Alternative A would result in vegetation conditions that are less resilient to disturbance than under the other action alternatives. Under alternative A, less progress would

likely be made toward attaining the desired conditions, given that this alternative lacks clear objectives related to managing wildfires for resource objectives and also lacks guidelines and management approaches that encourage the use of fire. The greater the departure from reference conditions, the weaker the resilience of the ERU.

Under alternative A, it is also expected that there would be fewer acres treated within wildland-urban interface (1987 Plan, page 137), wilderness, and Oak Creek Canyon, primarily as a result of restrictions on the use of wildfires managed to meet resource objectives and the lack of emphasis on the ecological need for fire in fire-adapted ERUs. Although wildfires managed for resource objectives are not explicitly prohibited under alternative A, plan direction creates constraints that increase the complexity and risk associated with implementing fire treatments in these areas. These constraints have resulted in no wildfires managed to meet resource objectives in wilderness areas since alternative A was signed in 1987. It is expected this would continue to be the case in the future.

As a consequence of these restrictions and the potential changes associated with climate change (increases in fuel loads, decrease in fuel moisture, and increased length of the fire season), wildfire frequency and fire severity may be higher in the long run in high-value and high-risk areas such as wilderness, wildland-urban interface, and Oak Creek Canyon under alternative A than under the action alternatives.

Alternative B (modified)

Under alternative B (modified), managing wildfires for resource objectives would be more probable (forestwide) as there are clear objectives consistent with fire treatment (FW-TerrERU-PP-O-3, FW-TerrERU-PJ-O-2, FW-TerrERU-PJ-Obj-3), as well as guidelines (FW-Fire-G-2) and management approaches that encourage the use of fire to move ERUs toward desired conditions.

Alternative B (modified) could result in substantially different outcomes in portions of the fire-adapted ERUs when compared with alternative A. Under alternative B (modified), each fire-adapted ERU has specific desired conditions (e.g., FW-TerrERU-PP-DC-2-3, FW-TerrERU-MC-MCFF-DC-4, -8, and FW-TerrERU-PJ-DC-4) that recognize the unique role of fire as a natural and essential component of properly functioning fire-adapted ecosystems. Taken together, these would result in more opportunities for treatment in certain areas, including wildfires managed to meet resource objectives throughout entire fire-adapted ERUs (including within wildland-urban interface, Oak Creek Canyon, and wilderness). Fire severity may still be relatively higher in some high-value and high-risk areas such as wilderness; but there would still be more treatment opportunities under this alternative than under alternative A. (See the specific ERU sections under the Environmental Consequences section for additional discussion of the implications of forest plan direction on composition, structure, function, and departure.)

Generally, the closer the ERUs are to the desired condition, the more resilient they are to the disturbances, including those that are magnified by climate change. Alternatives B (modified) and D should provide the most acreage treated in fire-adapted ERUs (with alternative C close behind) and result in lower overall departure with respect to desired conditions for vegetation and fire return interval (figure 4). Alternative A would result in the least acreage treated and less resilience overall. Furthermore, the closer a frequent fire-adapted ERU is to the desired conditions, the lower the potential to contribute to factors associated with climate change in the long term (e.g., reduced carbon storage and increased CO_2 released through uncharacteristic wildfire).

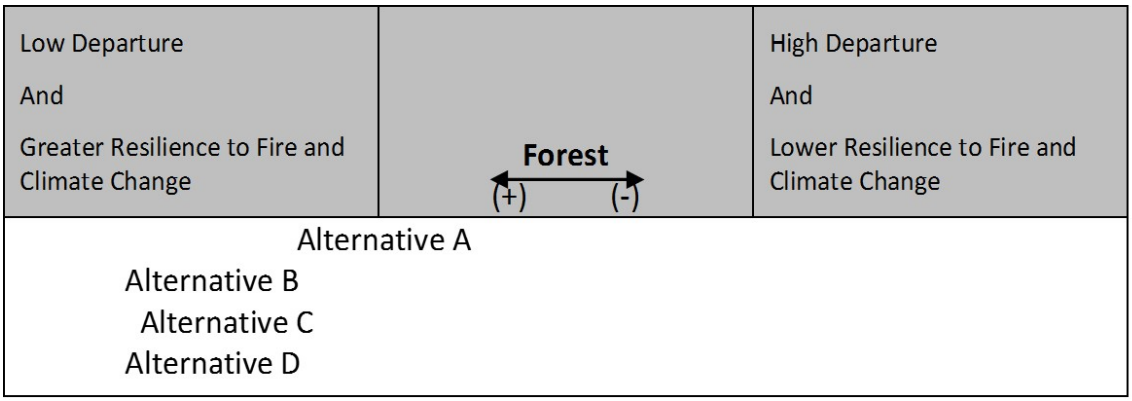


Figure 4. Relative departure from desired conditions, resilience and ecosystem health by alternative

The expected effects of climate change to grassland ERU can vary depending on a number of factors. For example, in Great Basin Grasslands, climate change could decrease ecosystem productivity because of water limitations and increased heat. However, the warmer and drier conditions could also potentially reduce the rate of vegetation departure by increasing the mortality rates of encroaching trees. Within high-elevation grasslands like the Montane/Subalpine Grasslands, the effects of climate change appears to be region- and site-specific. Based on field data and historical records, Dyer and Moffett (1999) concluded that climatic change is a more likely explanation for the encroachment of high-elevation spruce-fir trees into adjacent meadows, rather than fire suppression or changes in grazing intensity. However, this is not a general rule. In some instances meadow invasion has been attributed to a climatic warming and drying; in other areas the same outcome has been credited to a cooler and wetter climate. Dyer and Moffett (1999) found a potential interactive effect was indicated, with periods of establishment occurring with increased precipitation coupled with warmer temperatures; however, no unequivocal relationship between climate and tree establishment has been established.

Within the three Pinyon Juniper ERUs, the expected responses to climate change have some commonalities. Because they occupy transition zones between mesic forests at higher elevations and environments too dry for trees at lower elevations, Pinyon Juniper ERUs may be especially sensitive to subtle changes in temperature and precipitation. It is possible that some, or even much, of the infill and expansion of pinyon and juniper that has occurred during the past 150 years is a natural response to short-term and long-term climatic fluctuation. In the Pinyon Juniper Grassland ERU, which evolved with frequent fires, the vegetation composition, structure, and function is dependent on high-severity fires. In the face of climate change, drought and warmer temperatures become more common and create moisture stress in the existing trees. When paired with the current uncharacteristic accumulation of debris on the forest floor, fire intensity and severity increase resulting in uncharacteristic fire that kills more vegetation and damages soil. However, in Pinyon Juniper ERUs with longer fire return intervals such as Pinyon Juniper Evergreen Shrub and Pinyon Juniper Woodlands, the forest composition, structure, and function are probably much more closely tied to longer-term climate variations. Local soils and climate support a shrub community, but are probably dominated by trees during periods of moist climatic conditions or infrequent fires, and by grasses or shrubs during droughts or periods with more frequent fires or insect outbreaks (Romme et al. 2009). Tree densities could begin to decline due to increasing insect or fire activity as result of climate change, which would support increased grass and shrub cover indicative of a more static trend.

In other ERUs with longer fire return intervals such as Interior Chaparral and Mixed Conifer with Infrequent Fire, warmer and drier conditions would likely result in increases in mortality. In some cases, moisture stress decreases the resilience to disturbances like insects, diseases, and fire. In other cases, mortality can cause dieback of limbs or the whole plant, increasing fuel loads and the probability of severe wildfires affecting larger extents. In all cases, the mortality could cause substantial changes in composition, structure, and function.

Alternative C

Alternative C does not significantly differ from alternative B (modified) with respect to climate change. The outcome is expected to be the same.

Alternative D

Alternative D does not significantly differ from alternative B (modified) with respect to climate change. The outcome is expected to be the same.

Ecological Response Units

Introduction

For all terrestrial ERUs and under alternatives B (modified), C, and D, management direction would promote properly functioning ecosystems that are resilient to natural disturbances and climate change; promote characteristic disturbances and reduce the threat of uncharacteristic disturbances, and promote balance between desirable non-native species and subspecies and properly functioning ecosystems, thereby, furthering sustainability and adaptability (FW-Eco-DC-1-4, FW-TerrERU-All-DC-2). Plan components for all terrestrial ERUs promote a mosaic of vegetation conditions, densities, and structures at different scales; ecosystems that are interconnected based on natural patterns; and restoration of desired disturbance regimes (FW-TerrERU-All-DC-1-5, G-1, 3). The maintenance of ecosystems and native species would be further supported by preventing, controlling, or eradicating invasive species and managing invasive species at levels that do not disrupt ecological composition, structure, and function; do not disrupt the natural fire regime; or do not affect the sustainability of native and desirable non-native species (FW-Invas-DC-1, 2, G-1-3).

Table 21. Short-term and long-term vegetation departure rating and trend relative to reference condition by alternative (for both low and high treatment objectives in applicable ERUs)

ERU	Vegetation Departure Rating and Trend					
	Alternative A		Alternatives B (modified) and D		Alternative C	
	15 Year	50 Year	15 Year	50 Year	15 Year	50 Year
Desert Communities	High/ Away	High/ Away	High/ Away	High/ Away	Same as Alternative B (modified)	Same as Alternative B (modified)
Semi-desert Grassland	High/ Away	High/ Away	High / Toward	High / Toward	Same as Alternative B (modified)	Same as Alternative B (modified)
Great Basin Grassland	Low / Away	Moderate / Away	L:Low; H:Low /Static	L:Low; H:Low /Static	Same as Alternative B (modified)	Same as Alternative B (modified)
Montane/Subalpine Grassland	Low / Away	Moderate/ Away	L:Low; H:Low / Toward	L:Low; H:Low / Toward	Same as Alternative B (modified)	Same as Alternative B (modified)
Interior Chaparral	Low/ Away	Moderate/ Away	Low/ Away	Low/ Away	Same as Alternative B (modified)	Same as Alternative B (modified)
Pinyon Juniper with Grass	Moderate / Toward	Moderate / Away	L:Moderate; H:Moderate / Toward	L:Moderate; H:Moderate / Away	Same as Alternative B (modified)	L:Moderate; H:Moderate (L:48; H:43)/ Away
Pinyon Juniper Evergreen Shrub	Moderate/ Away	Moderate/ Away	Moderate/ Away	Moderate/ Away	Same as Alternative B (modified)	Same as Alternative B (modified)
Pinyon Juniper Woodland (Persistent)	Low/ Static	Low/ Static	Low/ Static	Low/ Static	Same as Alternative B (modified)	Same as Alternative B (modified)
Ponderosa Pine	L:High; H:Moderate /Toward	L:Moderate; H:Moderate /Toward	L:High; H:Moderate / Toward	L:Moderate; H:Moderate / Toward	Same as Alternative B (modified)	Same as Alternative B (modified)
Mixed Conifer with Frequent Fire	Moderate / Toward	Moderate / Static	L: Moderate; H: Low / Toward	L:Moderate; H: Low / Static	Same as Alternative B (modified)	Same as Alternative B (modified)
Mixed Conifer with Infrequent Fire	Moderate/ Away	High/ Away	Moderate/ Static	Moderate/ Static	Same as Alternative B (modified)	High/ Static
Spruce Fir	Moderate/ Toward	Moderate/ Toward	Moderate/ Toward	Moderate/ Toward	Same as Alternative B (modified)	Same as Alternative B (modified)
Alpine Tundra	Low/ Away	Low/ Away	Low/ Away	Low/ Away	Same as Alternative B (modified)	Same as Alternative B (modified)

Table 22. Fire return interval departure and trends for all ERUs under all alternatives

ERU	Predicted Departure and Trend for Fire Return Interval
	All Alternatives
Ponderosa Pine	High/Slowly Toward
Mixed Conifer with Frequent Fire	High/Very Slowly Toward
Mixed Conifer with Infrequent Fire	Moderate/Away
Spruce Fir	Moderate/Static
Pinyon-Juniper Woodland	Low/Away
Pinyon-Juniper Evergreen Shrub	High/Away
Pinyon-Juniper with Grass	Moderate/Away
Interior Chaparral	Moderate/Away
Montane/Subalpine Grassland	Moderate/Away
Great Basin Grassland	High/Away
Semi-desert Grassland	High/Away
Desert Communities	Not Fire-adapted
Alpine Tundra	Not Fire-adapted

Ponderosa Pine

Ponderosa Pine ERU requires frequent fire to maintain its composition, structure, and overall health. Low-severity fires historically occurred about every 2 to 20+ years (with an average of approximately 7 years) in Ponderosa Pine on the Coconino NF. Forestwide, fire treatment levels between 52,000 and 100,000 acres per year in the ponderosa pine would be required to be within the range of its historic fire return interval. Attaining a low fire departure from the historic fire return interval may be very challenging, given budgetary constraints and air quality concerns. In addition, there are some areas of ponderosa pine that have a structure and composition that would not allow treatment with fire alone. These areas would need mechanical treatment prior to burning to achieve an appropriate level of fire severity and avoid excessive damage to the vegetation and soil. However, desired conditions differ from reference conditions in that they recognize the limitations of managing resources within a complex socio-political landscape where, for instance, forests and private property intermingle in the wildland-urban interface and natural fires spark air quality concerns. Furthermore, the desired condition for some areas would promote and maintain canopy cover levels that are higher than indicated by historic reconstructions (based on best available science) to create specific habitat conditions that support threatened species recovery.

A large environmental analysis was recently completed covering a substantial portion of Coconino National Forest's ponderosa pine belt. Paired with the recently awarded 10-year stewardship contract, these two actions have paved the way for, what is expected to be, a substantial increase in pace of vegetation treatments over the previous decade. These treatments, which are part of the Four-Forest Restoration Initiative, focus on Ponderosa Pine restoration and are designed to meet regionally consistent desired conditions that mirror the desired conditions in the proposed forest plan. The treatments would occur regardless of the selected alternative under

this forest plan revision process. As such, the expected outcomes and the anticipated trends relative to departure from the desired conditions are similar across all alternatives (table 23, table 24, and table 25). The key differences are highlighted in the discussion below.

Alternative A

The existing forest plan provides direction with an emphasis on timber production, other forest products, livestock grazing, recreation, and wildlife habitat (1987 Plan, pages 117-118). In other management areas where ponderosa pine is not a major component, the management emphasis frequently differs and is largely unrelated to the presence of this species. Direction related to desired condition for this ERU is vague and is particularly ambiguous with respect to how structure, patterns, and function vary at different spatial scales.

The 1987 plan describes three distinct ponderosa pine vegetation types that differ based on the occurrence of other species; pure pine, pine with Gambel oak, and pine with aspen (1987 Plan, page 116) are all recognized as being part of a fire-dependent ecosystem. Management is based on 10,000-acre blocks that are established across the forest (1987 Plan, page 70). Within each 10,000-acre block, the 1987 Plan directs that vegetation is managed to meet multiple resource objectives such as timber volume maximization (1987 Plan, page 123), minimum wildlife cover (1987 Plan, pages, 124-125), and wildlife habitat components (1987 Plan, pages 125-127). Uneven-aged management is emphasized and standard prescription guidelines are provided for ponderosa pine under various scenarios (1987 Plan, pages 130-135). Additional guidance is provided with regard to species habitat requirements (see Mexican spotted owl and northern goshawk discussion below).

There is direction to conform to the Mexican Spotted Owl Recovery Plan (1987 Plan, page 64). However, species recovery plans may be revised over the life of a forest plan. Currently, under alternative A, language from an earlier version of the Recovery Plan is integrated into the 1987 Plan and is in conflict with the most current recovery plan recommendation, does not reflect current science, and could be in conflict with future recovery plan revisions. For example, the language that was integrated into the current forest plan refers to “protected habitat” and “restricted habitat,” which are outdated terms that are no longer used (1987 Plan, page 65). Furthermore, the current recovery plan recognizes that stand-replacing wildfires are the greatest threat to Mexican spotted owl habitat and does not recommend diameter caps (USDI Fish and Wildlife Service 2012b).

The 1987 Plan states that all pine-oak forests are considered to be Mexican spotted owl restricted habitat; in addition, pine-oak areas that are on slopes greater than 40 percent where timber harvest has not occurred in the last 20 years are also considered protected habitat (1987 Plan, page 65). Emphasis is placed on retaining relatively high densities and retaining and promoting large oaks (1987 Plan, pages 65 to 65-4). There is a 9-inch d.b.h. limitation on tree cutting in most protected activity centers and on steep slope protected habitat for fire risk abatement in the current forest plan (1987 Plan, page 65-2, 65-3). This diameter cap is not as effective as other approaches in reducing the risk of fire and is not considered to be a valid approach for promoting and sustaining Mexican spotted owl habitat. Harvest activities, are limited and only fire risk abatement treatments and some fuelwood harvests are permitted in protected habitat. As a consequence of this direction and the associated treatment limitations (1987 Plan, pages 65; 65-2 – 65-4), past treatments prescribed under the existing Forest Plan have been too conservative to either maintain the desired age and structural diversity or to abate fire risk. Rather, treatments have tended to

leave unnecessarily high stocking densities which increase the risk of uncharacteristically severe wildfires in this ERU.

Prescribed fire is permitted through much of the protected and restricted areas except for select areas around nests designated for “no treatment” (1987 Plan, pages 65-2 to 65-4). Only fuelwood harvest and fire risk abatement mechanical treatments are permitted in protected activity centers except within the 100-acre “no treatment” area. Fire risk abatement mechanical treatments are also permitted on steep slopes outside of PACs (1987 Plan, page 65-3). Across all these areas, thinning is primarily limited to conifers less than 9 inches d.b.h. (1987 Plan, page 65-2). In 10 percent of the restricted habitat, that would be managed for nesting and roosting habitat, the basal area threshold is set to a minimum 150 square feet per acre, which is higher than the 110 square feet per acre minimum threshold identified under the current recovery plan (USDI Fish and Wildlife Service 2012b).

As a consequence of these standards and guidelines (1987 Plan, pages 65; 65-2 to 65-4), past treatments prescribed under the existing Forest Plan have left some areas with high tree densities that do not promote resilience and increase the forest’s susceptibility to insect and disease outbreaks and uncharacteristic wildfires. In these areas, high tree densities discriminate against Gambel oak and early seral species like aspen which are a desired habitat component.

Under the current Forest Plan, most forest types that are not classified as restricted habitat under Mexican spotted owl or management-limited by other specified requirements are managed for northern goshawk habitat, which provides guidance for structural diversity. The plan direction emphasized uneven-aged structure and canopy cover retention as well as snag, minimum levels for logs and woody debris for various habitat categories (1987 Plan, pages 65-9 – 65-11). General direction is provided to manage for old age trees such that as much old forest structure as possible is sustained over time across the landscape and to sustain a mosaic of vegetation densities (overstory and understory), age classes and species composition across the landscape (1987 Plan, pages 65-7, 70-1, 70-2). Very specific direction is provided in terms of canopy cover provided by different vegetation structural stages (VSS) (1987 Plan, pages 65-9 to 65-11). For the purposes of this analysis, VSS are represented by vegetation states. A crosswalk between VSS and vegetation states can be found in appendix C of the Vegetation and Fire specialist report (USDA Forest Service 2016c). Specific stocking guides within large openings (1987 Plan, page 65-10) may make it difficult to achieve desired conditions as the reserved trees would serve as a seed source and accelerate the restocking of areas intended to remain open.

Additional specific guidance provides for satisfactory stocking ranges from 120 to 325 trees per acre depending on site class and management objectives (1987 Forest Plan, page 121). A recent literature review of early historical inventories and reconstructions of ponderosa pine, the most comprehensive to date, recently indicated that the historic range of variation for ponderosa pine forests on basalt soils in the Coconino NF averages between 15 and 60 trees per acre (Reynolds et al. 2013). Densities varied across the Colorado Plateau depending on forest type, location, soil parent material, and elevation. However, these densities (even if adding additional understory trees that are often missed in reconstructions) are still far below the low end of the stocking range provided in the 1987 Plan. As a consequence, this alternative would promote higher tree densities than are desired and appropriate for this ERU.

In the current forest plan, the policy cited (FSM 2471 and FSH 2409.26d) guides that management would primarily use uneven-aged systems (goshawk guidelines). In rarer cases,

when stands are managed under even-aged systems, the shelterwood method is the preferred method. In these cases, the standard ponderosa pine mixed conifer silvicultural prescription (1987 Plan, page 130) is to cut pine to approximately 30 growing stock level (GSL) and mixed conifer to approximately 60 GSL using one to four commercial (intermediate) cuts and harvesting when the available average cut volume/acre is at least 160 cubic feet per acre for the sale area. Although economic feasibility must be considered for all proposed treatments, this guidance seems to emphasize commodity production over habitat improvement or restoration.

Additional direction for basal area (BA) and GSL density is provided for wildlife hiding and thermal cover required on 30 percent of each 10,000-acre block, but it is designed for even-aged ponderosa pine and mixed conifer (1987 Plan, pages 124, 124-1, 125). The presence of non-commercial species, such as Gambel oak, New Mexico locust, juniper, aspen, and bigtooth maple, or topographic features such as drainages or other terrain breaks, rocky outcrops, or large surface boulders, would normally result in retaining less stocking (BA/GSL) of commercial species to meet cover requirements. The Forest Plan definition of GSL is: The stand density level, usually expressed as a number of trees per acre or basal area per acre in square feet, using trees 10+ inches d.b.h. to calculate BA, needed to maintain optimum tree growth through the life of a stand. It is often difficult to determine whether GSL refers to basal area or trees per acre, particularly in smaller size classes. This guidance is another example of where perhaps a lack of clarity has led to conservative treatments that may not have led to achievement of overall desired conditions.

Fire treatment using prescribed fire and managed wildfires may be used to meet resource objectives; however, wildfires managed for resource objectives are prohibited in the wildland-urban interface (1987 Plan, pages 92, 137). Under alternative A, the annual average wildfire acreage burned should not exceed 750 acres per year on the average over a 10-year period in MA 3 (1987 Plan, page 137). These limitations to the role of fire in the ecosystem were designed to protect ponderosa pine suitable timberlands, but they also serve to inhibit the restoration of this ERU. The objectives of prescribed fire outside of the wildland-urban interface are to accomplish fuel treatment and resource management (1987 Plan, page 94). The suppression objective is to minimize impact on the land while keeping fires to 10 acres or less in areas mapped as the wildland-urban interface (1987 Plan, page 93). Prescribed fires outside the wildland-urban interface are intended to meet resource objectives while also protecting life, property, private in-holdings, and other landownership, while holding fires to 100 acres or less (1987 Plan, pages 94, 137).

See the old growth discussion earlier in the Environmental Consequences section for information with regard to old-growth allocations and the ability to achieve the desired distribution of vegetation states.

Departure and trend from reference condition:

The vegetation condition is currently highly departed with a trend away from the desired conditions. The fire return interval is also highly departed and trending slowly toward the desired conditions. As discussed above, the desired conditions, where they are expressed in terms of a distribution of vegetation states, are not intended to be, nor should they be considered as outcomes at fine and mid scales. The desired vegetation distribution is a long term target evaluated exclusively at very large landscape scales (specifically at the full extent of the ERU). At any one time, the distribution could depart substantially at the stand scale and even at the scale

of entire watersheds. While this ERU does not have specific treatment objectives under this alternative, it is expected that a substantial portion of the ponderosa pine ERU would receive treatment through the actions associated with the Four-Forest Restoration Initiative discussed above.

Under this alternative (and others), the expected treatments would generally decrease tree density in the vegetation states that are currently overrepresented. Small trees would be removed and medium to large trees that occur in a closed state would be converted to an open state that more closely approximates the regionally consistent desired condition for restored ponderosa pine forests (table 23 and table 25). In those areas that require pre-treatment, the historic fire regime can be reintroduced without compromising the residual vegetation after mechanical treatment is complete.

The ERU would generally be managed for large trees, large hardwoods, large snags, and large downed woody debris (1987 Plan, pages 65-1 to 65-4; 65-9 to 65-11). In areas where higher tree density is maintained, such as within protected Mexican spotted owl habitat and designated wilderness, the risk of uncharacteristic fire is still higher than elsewhere. Early seral species, such as aspen, may continue to decline where late seral species or closed canopy conditions are emphasized.

While prescribed fires and managed wildfires may be managed for resource objectives, under this alternative, wildfires within the wildland-urban interface must be suppressed (1987 Plan, page 137). Where managed fires are permitted to function in their natural roles, appropriate open conditions would be maintained, essential nutrient cycling would occur, and age class diversity would be promoted. In the short term, maintenance of open conditions would slow encroachment of trees. In the long term, fire intervals that are closer to desired conditions would also encourage subdominant species such as aspen and Gambel oak. Any restriction on the natural role of fire would slow the pace at which desired conditions can be achieved locally and may increase the risk of uncharacteristic wildfires.

The following tables are based on a series of treatment projections. These are not treatment objectives because alternative A does not have any. Rather, these ranges were calculated based upon the average number of acres mechanically treated on the forest over the past decade and the estimated annual number of acres that could be treated mechanically and with prescribed fire under the Four-Forest Restoration Initiative.

- Use prescribed cutting to treat 50,000 to 260,500 acres of Ponderosa Pine during each 10-year period over the life of the plan.
- Use prescribed fire to underburn 150,000 to 200,000 acres of Ponderosa Pine within the natural fire regime during each 10-year period over the life of the plan.
- Use naturally ignited wildfires (i.e., lightning-caused fires that are managed for resource objectives) to treat 135,000 acres of Ponderosa Pine within the natural fire regime during each 10-year period over the life of the plan.

Using wildfires to meet resource objectives would depend on the location of ignitions, conditions at the time of ignition, and resources at risk. The model assumed that all 13,500 acres were successfully treated each year with wildfires. However, wildfires managed for resource objectives are not permitted within the wildland-urban interface under this alternative. Based on conservative estimates, this restriction could impact at least 24 percent of the ERU. Therefore, there may be notable differences in the outcomes at the local scale. See the wildland-urban

interface section of this report for additional discussion. Ponderosa Pine was modeled in three different ways: (1) the entire ERU combining both suitable and non-suitable timberlands; (2) only suitable timberlands, and then; (3) only non-suitable timberlands. This approach provides additional insight into how the two different kinds of management requirements combine to move the landscape toward desired conditions.

Table 23. Desired, existing, and expected distribution of Ponderosa Pine states - All alternatives

Ponderosa Pine Qualitative State	Desired Distribution [11]	Existing Distribution	Low Objective		High Objective	
			15 Year	50 Year	15 Year	50 Year
Grass, Forb, Brush/Shrub[1]	0.0%	0.8%	2.7%	4.1%	2.6%	3.7%
Seedling/Sapling, Even-aged, Open and Closed[2]	1.4%	0.0%	6.9%	11.6%	8.1%	12.1%
Small Trees, Open, Even-aged[3]	1.4%	19.3%	5.1%	4.2%	5.4%	5.2%
Very Large and Medium Trees, Open, Even-aged[4]	88.0% more than half multistoried	6.4%	9.0%	11.1%	8.5%	10.0%
Very Large and Medium Trees, Open, Uneven-aged[5]	1.4%	4.2%	11.4%	15.8%	23.8%	27.1%
Small Trees, Closed, Even-aged[6]		0.0%	10.4%	14.9%	10.1%	13.9%
Very Large and Medium Trees, Closed, Even-aged[7]	7.8%[10]	45.1%	29.6%	13.5%	21.1%	8.8%
Very Large Trees and Medium Trees, Closed, Uneven-aged[8]		24.2%	25%	24.9%	20.5%	19.3%
Total ERU Departure[9]		80%	68%	61%	56%	51%

[1] In the VDDT modeling described in appendix C, this row represents states A and N (Brush/Shrub results from uncharacteristic fire –with delayed recovery time for State N)

[2] In the VDDT modeling described in appendix C, this row represents states B and F

[3] In the VDDT modeling described in appendix C, this row represents state C

[4] In the VDDT modeling described in appendix C, this row represents states D and E.

[5] In the VDDT modeling described in appendix C, this row represents states J and K.

[6] In the VDDT modeling described in appendix C, this row represents states G

[7] In the VDDT modeling described in appendix C, this row represents states H and I.

[8] In the VDDT modeling described in appendix C, this row represents states L and M.

[9] Departure from reference conditions = high (over 66%), moderate (34% to 66%), and low (0% to 33%).

[10] Desired distributions do not include Mexican spotted owl protected activity centers, which would be managed under the Mexican spotted owl recovery plan.

[11] Desired distributions come from ERU Crosswalk calculator using 40% PIPO-Gambel Oak and 60% PIPO Bunchgrass.

Over the life of the plan, alternative A (as well as the other alternatives) would improve the vegetative structure and composition of the ERU (table 23 and table 25) and in so doing, would also reduce the risk of uncharacteristic fire. The huge disparity between closed and open canopy states that currently exists would be reduced to almost equal after 50 years at the high treatment level, and the areas having medium and very large trees with uneven-aged structure would start to represent a majority of the ERU. On the other hand, at the low treatment level, the closed canopy

states would still remain at least 70 percent more abundant than the open states. Alternative A would put this ERU on a trend toward desired conditions by improving stand structure, opening up the canopy, and reducing the overall departure; however, the rate at which departure reductions would be achieved is greater at the high treatment level. This ERU is currently highly departed with respect to vegetation, but at years 15 and 50, it would become moderately departed at the high treatment objective; at the low treatment level, it would remain highly departed in the short term (but at the low end of high departure and considerably improved over the current condition). It would be moderately departed at the low treatment level by year 50. In both cases, this ERU would remain on a positive trend over the next 50 years. As a result of these changes in tree structure and composition, the diversity and distribution of understory vegetation are expected to increase where open stand conditions are created.

Movement toward desired conditions is partly a function of acres treated (though the distribution and spatial arrangement of the vegetation is also an important component). The more acres treated, the greater the movement toward desired conditions (table 25). The low treatment level would mechanically treat an average of 5,000 acres annually, whereas at the high treatment level 26,050 acres would be mechanically treated. Under both scenarios, the rate of change would level off dramatically after some substantial gains in the first 15 years. Nevertheless, even based on the high treatment level, the number of mechanically treated acres is not enough to achieve low departure over the time period modeled. Vegetation conditions may improve by managing additional wildfires to meet resource objectives, but this option is not available within wildland-urban interface under alternative A.

Timber management may occur on unsuitable lands, but is driven by other resource objectives such as, wildlife habitat improvement or fire regime restoration. The only unsuitable lands modeled for this report were Mexican spotted owl protected activity centers (PAC), which were thinned from below up to 9 inches d.b.h. to reduce wildfire risk; though under the action alternatives larger trees may also be removed when appropriate and in consultation with the Fish and Wildlife Service. Appendix F of the Vegetation and Fire specialist report (USDA Forest Service 2016c) compares the modeled outputs for suitable and unsuitable timber lands in more detail. The greatest movement toward desired conditions and reduction of departure is achieved through treatments on suitable timberlands (table 24).

Table 24. Effects of different treatment levels on the amount of vegetation departure within suitable and unsuitable areas for all alternatives

Suitability	Initial Departure	Low Objective Post-treatment		High Objective Departure Levels	
		15 Year	50 Year	15 Year	50 Year
Suitable Timber	84%	65%	57%	45%	40%
Unsuitable Timber	75%	71%	67%	71%	67%
Combined (Suitable and Unsuitable Timber)	80%	68%	61%	56%	51%

After 50 years of treatments at the high treatment level, the vegetation condition on suitable lands begins to approach a low level of departure. Impressive positive trends toward desired conditions are seen in States D, E, J and K, which are dominated by medium and very large trees with open canopies and multi-storied (uneven-aged) structure; in addition, closed canopy states for medium

and very large trees (H, L, I, M) are also set on a positive trend, with most moving to states J and K or D and E (see appendix F). Under the lower treatment level, the pattern is generally the same. There is still a decrease in departure, but it is not as great as under the high treatment level. Under both the low and high treatment levels, unsuitable timberlands experience similar positive trends in most states, but they are not as pronounced as in suitable timberlands due to differing management requirements and the related limitations on timber management options (such as diameter limits to thinning in PACs).

Table 25. VDDT modeled Ponderosa Pine vegetation states expected under all alternatives (A, B (modified), C, and D) based on the low and high objectives

State	Description	Desired Distribution[1] %	Current Distribution %	Low Objective		High Objective	
				Year 15 Distribution	Year 50 Distribution %	Year 15 Distribution %	Year 50 Distribution %
A N	A – Grass, Forb, Brush/Shrub N – Grass, Forb, Brush/Shrub Resulting from Uncharacteristic Fire (delayed recovery time).	0.0	0.4 0.4	1.2 1.5	1.8 2.3	1.1 1.5	1.9 1.8
Sub-total (A&N):			0.8	2.7	4.1	2.6	3.7
B F	B – Seedling, Sapling, Open, SS2 F – Seedling, Sapling, Closed, SS	1.4	0.0 0.0	1.6 5.3	2.3 9.3	2.0 6.1	2.7 9.4
Sub-total (B&F):			0.0	6.9	11.6	8.1	12.1
C	Small Trees, Open, SS	1. 4	19.3	5.1	4.2	5.4	5.2
D E J K	D – Medium Trees, Open, SS E – Very Large Trees, Open, SS J – Medium Trees, Open, MS3 K – Very Large Trees, Open, MS	88. 0 Primarily J & K	5.4 1.0 3.2 1.0	5.2 3.8 7.1 4.3	2.8 8.3 7.6 8.2	4.9 3.6 12.7 11.1	3.1 6.9 10.1 17.0
Sub-total (D,E,J,K):			10.6	20.4	26.9	32.2	37.1
G	G - Small Trees, Closed, SS	1. 4	0.0	10.4	14.9	10.1	13.9
H I L M	H – Medium Trees, Closed, SS I – Very Large Trees, Closed, SS L – Medium Trees, Closed, MS M –Very Large Trees, Closed, MS	7.8	39.9 5.2 21.6 2.6	24.0 5.6 20.8 4.2	9.0 4.5 18.5 6.4	16.8 4.3 17.0 3.5	6.1 2.7 14.1 5.2
Sub-total (H,I,L,M):			69.3	65.0	38.4	41.6	28.1
Level of Departure[4]:		0%	80%	68%	61%	56%	51%

[1] Desired distribution comes from ERU Crosswalk calculator using 40% PIPO-Gambel Oak and 60% PIPO Bunchgrass.

[2] SS = Single story (Even-aged).

[3] MS = Multiple Story (Uneven-aged).

[4] Departure Levels = High (>66%), Moderate (34-66%), and Low (0-33%).

Across all suitable and unsuitable acres under the low and high treatment objectives, grasses, forbs, and brush/shrubs (States A and N) are projected to move away from the desired condition after the first 15 years and continue to move away after 50 years. This state represents openings that are at the mid-scale (100 to 1,000 acres), and are not generally desired within this ERU. It is important to note that the desired openings for grass, forb, and shrub understory vegetation are built into open single storied states and throughout the multistoried states, but are not identified separately. The continued increase in the grass, forb, and brush/shrub state is attributed to larger than desired openings being created, primarily by wildfires and the resulting longer time period required to move back into a forested state.

Seedlings and saplings with open canopy (State B) and closed canopy conditions (State F) are projected to meet and then exceed the desired condition after 15 years under low and high treatment objectives. The trend is predicted to continue over the next 50 years. This increase in seedlings and saplings (primarily closed canopy) is attributed to the number of acres being treated failing to keep up with the pace of natural regeneration and tree growth. Due to competitive interaction, seedlings and saplings would start to stagnate and move mostly from State B to F or from state F into the closed small tree stage (State G). The relative proportion of these states remains higher than is desired conditions for this ERU. Vegetation conditions, particularly in seedlings and sampling, may improve by managing additional wildfires for resource objectives, but this treatment tool is not available within wildland-urban interface under alternative A (1987 Plan, page 137). This means that seedlings and saplings (a common component of ladder fuels) may be especially prevalent within the wildland-urban interface and favor closed canopy conditions.

Small trees with open canopy conditions (State C) are projected to make substantial movement toward the desired condition after 15 years, reducing from 19 percent to about 5 percent under both low and high treatment objectives. This trend is projected to continue, but at a much slower rate, still not reaching the desired condition after 50 years. Increased movement of small trees into this state would continue to occur as closed canopies are mechanically thinned. States D, E, J, and K, make up the vast majority of the desired distribution. It is important to note that that States J and K are both multi-storied (uneven-aged) and have at least three age classes represented, including adequate openings for planned regeneration immediately after treatment. Although a state is described as “medium” or “very large” trees, it should be inferred that trees of other sizes/ages are also present. For example, State J is dominated by 10- to 20-inch d.b.h. trees, but it would also include a more or less balanced representation of seedlings/saplings, small trees, and some very large trees since it represents a multi-storied, uneven-aged state.

Under both the low and high treatment objectives, States D, E, J, and K are projected to cumulatively move toward the desired condition after 15 years and continue on a positive trend over 50 years, but they would still remain well short of the desired distribution for medium and very large trees growing under open conditions. A great deal more progress is made under the high treatment objective, than under the low treatment objective. Across the landscape, closed canopy conditions would still dominate this ERU and contribute to an underdeveloped understory layer, reduced growth rates of trees, an overall maintenance of even-aged structure, and a greater relative risk to uncharacteristic fires. After 50 years, it is expected that the proportion of the ERU under open conditions would be greater than that under closed conditions under the high treatment objective. Conversely, under the low treatment objective, closed canopy conditions would still represent the majority of the ERU. Under both treatment objectives, the amount of mechanical treatment is not high enough to achieve the desired condition over the long term.

Mechanically treating 26,050 acres per year (high treatment objective) equates to a 20-year return interval. This is approximately the amount of time typically prescribed, using silvicultural techniques, to move toward desired uneven-aged conditions. The result of a 20-year return interval created by mechanically treating 26,050 acres is moderate movement toward desired conditions. Prescribed fire and

wildfires managed for resource objectives is the most practical and economical way to maintain this open condition across the full ponderosa pine landscape over the long term. Among other benefits, fire removes overrepresented seedlings and saplings that could eventually grow into the overstory, essentially negating the effects of previous mechanical treatments. Direction under alternative A prohibits managing wildfires to meet resource objectives in wildland-urban interface (1987 Plan, page 137). This can result in slower progress toward the desired conditions in these areas.

Small trees with closed canopy (State G) are projected to increase under both the high and low treatment objectives, reaching and then exceeding the desired condition within 15 years. This is attributed to the growth of seedlings and saplings into this size class as well as the movement of small trees from open (State C) to closed canopy conditions. After 15 years, the trend continues and moves farther away. Canopy closure continues to increase, slowing tree growth and movement into the next size class. Under both treatment objectives, the number of acres treated is insufficient to reverse this negative trend over the modeled time period.

States H, L, I, and M, which are indicative of mature closed forest habitat and occasional even-aged dynamics, trends toward desired conditions after 15 years (under both high and low treatment objectives) as medium and large-sized trees under closed canopy conditions move into open canopy states and uneven-aged structure. State I contains primarily very large trees and is described as single-storied (even-aged), but may also contain up to one other distinct size/age class and scattered single trees of different sizes. After 50 years the trend for this group of closed canopy states continues falling, from almost 65 percent down to 38 percent of the ERU under the low treatment objective and from 41 percent down to 28 percent of the ERU under the high treatment objective. Under both objectives, the level of departure is still well away from desired conditions.

Generally speaking, as a greater proportion of the Ponderosa Pine ERU is made up of uneven-aged states, it would become more structurally diverse. Understory vegetation is also expected to respond favorably to treatment. As the amount of open canopy in the ERU increases over the next 50 years, conditions would favor a greater diversity of grasses, forbs, and shrubs, which in turn supports a wider variety of wildlife species.

In the existing Forest Plan, a ponderosa pine/mixed conifer snag is defined as a tree greater than 12 inches d.b.h. and 15 feet tall, and a minimum should be maintained at an average of 200 snags per 100 acres across 50 percent of the forested landscape (1987 Plan, page 126). Snag requirements for old-growth mixed conifer are a minimum of 2.5 trees per acre that are 20 feet tall and 14 inches d.b.h. (low site) or 25 feet tall and 16 inches d.b.h. (high site). In Mexican spotted owl restricted habitat, an unspecified, but “substantive” number of snags 18 inches d.b.h. and larger should be retained (1987 Plan, page 65-5). In landscapes outside goshawk post-fledging family areas at least 2 snags (defined as 18 inches d.b.h. or larger and 30 feet high or larger) should be present (1987 Plan, pages 65-9 and 10. Under alternatives B (modified), C, and D, snags are at least 18 inches d.b.h. and average 1 to 2 per acre across the landscape (FW-TerrERU-PP-DC-5). Under all alternatives, snags of various sizes would be present across the landscape (table 26), adding complexity to forest structure and providing habitat components for multiple species. The numbers of snags are expected to remain static or increase.

Table 26. Predicted snag density by size class in Ponderosa Pine under all alternatives (A, B (modified), C, and D

	Low Objective			High Objective		
	8 to 12 inches d.b.h.	12 to 18 inches d.b.h.	18+ inches d.b.h.	8 to 12 inches d.b.h.	12 to 18 inches d.b.h.	18+ inches d.b.h.
Existing	2.8	1.2	1.3	2.8	1.2	1.3
15 years	3.1	1.8	1.4	2.9	1.7	1.4
50 years	2.9	1.7	1.4	2.7	1.5	1.4

While alternative A does not have specific treatment objectives, it was analyzed based on a predicted range of treatment levels described above. The model used to develop the preceding predictions assumed that mechanical treatments, prescribed fire treatments, and wildfires managed for resource objectives would all occur over the life of the plan. While the mechanical treatments are expected to have similar results across all alternatives, alternative A places additional restrictions on the location of wildfires managed for resource objectives. Although the extent and location of wildfires cannot be predicted, it is still reasonable to assume that under this alternative ignitions may occur in areas where the use of this management tool is prohibited (at least 24 percent of the ERU is within wildland-urban interface). During periods of time when conditions are appropriate and resources are available, beneficial wildfires would still be suppressed. As such, opportunities in these locations to restore the historic fire regime and meet vegetation objectives may be missed. Those areas left untreated because of these restrictions are more likely to experience uncharacteristic fires and as a result, may experience greater than desired severity, soil impairment, and create greater threats to surrounding communities.

Overall, under this alternative, vegetation is expected to trend toward desired conditions and become moderately departed after 15 years under the high treatment objective. Under the low treatment objective, the vegetation condition of this ERU is expected to remain highly departed in the short term (but at the low end of high departure and considerably improved over the current condition). It would be moderately departed at the low treatment level by year 50. Under both treatment objectives, vegetation would continue trending toward the desired conditions over the next 50 years. Fire return interval departure is expected to remain high while slowly trending toward the desired conditions. Conditions may improve by managing wildfires to meet resource objective if they occur is appropriate places, but this option is not available within wildland-urban interface under alternative A.

Alternative B (modified)

This ERU occurs in 14 different proposed management areas (Volcanic Woodlands, Pine Belt, San Francisco Peaks, Flagstaff Neighborwoods, Mount Elden, Walnut Canyon, Anderson Mesa, Lake Mary Watersheds, Red Rocks, Oak Creek Canyon, Verde Valley, Long Valley, East Clear Creek, and C.C. Cragin Watersheds) under Alternative B (modified). The majority (75 percent) occurs within Pine Belt (43 percent), Long Valley (19 percent), Anderson Mesa (7 percent), and Lake Mary Watersheds (6 percent). Alternative B (modified) provides a great deal more direction than alternative A with regards to desired conditions at multiple scales including a range of tree density (in terms of basal area), a range of the percentages of areas in openings, size and number of trees per group, endemic levels of disturbances such as insects, disease, fire, and weather. Rather than focusing on production and minimizing natural disturbances as seen under alternative A, this alternative emphasizes restoration of the historic composition, structure, and function of the ERU. Other than the management direction that applies to all terrestrial ERUs (FW-Eco-DC-1 to 4; FW-TerrERU-All-DC-1 to 5; FW-TerrERU-All-S-1 to 4; FW-TerrERU-All-G-1 to 4) and that which is specific to this ERU (FW-TerrERU-PP-DC-1 to 15; FW-TerrERU-PP-O-1, 2, 3; FW-TerrERU-PP-G-1 to 7), additional guidelines are provided with regard to structure and composition, where applicable, by reference to following approved recovery plans and

complying with species conservation agreements, assessments, strategies, or national guidelines (FW-WFP-DC-1, 2).

The proposed guidance under this alterative would ensure that treatments achieve conditions that are regionally consistent and more accurately represent the best available science and the historic composition, structure, and functions of this ERU. There would be a greater emphasis on promoting an uneven aged structure that provides for long-term sustainability and contains old-growth components across the entire landscape in the distribution and arrangement that they historically occurred (FW-TerrERU-PP–DC-1 to 15; FW-TerrERU-PP-G-1 to 4). Particular attention is also given to identifying and retaining pre-settlement trees (FW-TerrERU-PP-G-3) which contribute to old growth conditions characteristic of the vegetation type.

In contrast to alternative A, under alternative B (modified), the formative and restorative role of fire in a fire-adapted ecosystem is recognized (Fire Management Section, FW-TerrERU-All-DC- 1, 2, FW-TerrERU-All-G-2; FW-TerrERU-PP-DC- 1, 3, 11) and the proposed Forest Plan direction specifically provides for its use as a management tool (FW-Fire-G, FW-TerrERU-PP-G-1).

Under this alternative, the Forest Plan direction provides for northern goshawk habitat requirements within this ERU (FW-TerrERU-PP-DC-12) without being overly prescriptive, as is the case under alternative A (1987 Plan, pages 65-7 to 65-11). Specifically, the direction cites the need for higher basal areas in mid-aged to old-aged tree groups in northern goshawk post-fledging areas and that in nest areas, forest conditions should be multi-aged and dominated by large trees with relatively denser canopies than other areas in Ponderosa Pine (FW-TerrERU-PP-DC-12). Some areas within Mexican spotted owl PACs and recruitment nesting and roosting areas would also have higher basal areas and higher canopy cover following the guidance provided in the current Mexican spotted owl recovery plan (FW-WFP-G-1).

Unlike alternative A, which does not have specific treatment objectives, under alternative B (modified), there are three identified treatment objectives:

- Use prescribed cutting to treat 50,000 to 260,500 acres of Ponderosa Pine during each 10-year period over the life of the plan.
- Use prescribed fire to underburn 150,000 to 200,000 acres of Ponderosa Pine within the natural fire regime during each 10-year period over the life of the plan.
- Use naturally ignited wildfires (lightning-caused fires that are managed for resource objectives) to treat 135,000 acres of Ponderosa Pine within the natural fire regime during each 10-year period over the life of the plan.

These treatment objectives were calculated based upon the average number of acres mechanically treated on the forest over the past decade and the estimated annual number of acres that could be treated mechanically or with prescribed fire under the Four-Forest Restoration Initiative. Achieving the objective related to wildfires managed for resource objectives would depend on the location of ignitions, conditions at the time of ignition, and resources at risk. The number of acres treated may exceed or fall below this objective depending on conditions.

Under this alternative, 97 acres of this ERU would fall within the Abineau (68 acres) and Strawberry Crater (29 acres) recommended wilderness areas. If designated by Congress, the wilderness areas would be managed according to applicable laws, policy and Forest Plan direction. Law, regulation, and policy typically limits mechanical vegetation management in wilderness areas however plan language would facilitate the treatment of these areas with fire (see Wilderness section) and would move ponderosa pine away from vegetation and fire desired conditions over the long term in portions of these two areas. There would be an increased risk of uncharacteristic fire, higher than desired fire severity, and a decreased

likelihood of restoring natural fire interval in these two recommended wilderness areas. However, the total number of acres being proposed beyond those that are already designated as wilderness is so small (0.02 percent of the total ERU managed by the forest) that the impact to the ERU overall is negligible.

Departure and trend from reference condition:
Alternative B (modified) was modeled in much the same way as Alternative A largely because the anticipated treatments authorized under the Four-Forest Restoration Initiative would make up the majority of the planned vegetation treatments within this ERU over the next 10 years. Since the activities are expected to be largely the same under both alternatives, the consequences are also expected to be largely the same. In general, this alternative would improve the vegetative structure and composition of the ERU (table 23 and table 25) and in so doing, would also reduce the risk of uncharacteristic fire. Under the high treatment objective, the huge disparity between closed and open canopy states that currently exists would be reduced to almost equal after 50 years, and the areas having medium and very large trees with uneven-aged structure would start to represent a majority of the ERU. Less progress would be made under the low treatment objective. Alternative B (modified) would put this ERU on a trend toward desired conditions by improving stand structure, opening up the canopy, and reducing the overall departure. This ERU is currently highly departed with respect to vegetation, but would become moderately departed under the high treatment objective after 15 years and remain on that positive trend over the next 50 years. Under the low treatment objective, vegetation departure would improve, but remain high after 15 years. As a result of these changes in tree structure and composition, the diversity and distribution of understory vegetation are expected to increase where open stand conditions are created.

See the discussion under alternative A for a detailed description of the effects of anticipated treatments on the vegetation states, state transitions, and the implications to fire regime restoration (table 23, table 24, and table 25). While the outcomes under both alternatives are broadly similar, there are also important differences that are worth noting. Within the vegetation states where open canopy conditions are a key functional element (States C, D, E, J, and K), any emphasis on suppression or limits on the use of wildfires to meet resource objective could have a negative effect on the rate at which desired conditions may be achieved. This is the case under alternative A where wildfires may not be managed for resource objectives in the wildland-urban interface (1987 Plan, page 137); however, under alternative B (modified) there are no such restrictions. Where wildfires are permitted to function in their natural roles, appropriate open conditions could be maintained, essential nutrient cycling would occur, and age class diversity would be promoted. In the short term, maintenance of open conditions would slow the development of closed forest canopy. In the long term, fire intervals that are closer to desired conditions would also encourage subdominant species such as aspen and Gambel oak. In vegetation states where the canopy is closed (State G), alternative B (modified) would permit a beneficial use of wildfires and foster an increase in the rate of small tree diameter growth by reducing density. In contrast to alternative A, this would move small trees into the larger tree states faster and reduce the risk of uncharacteristic fire in wildland-urban interface, wilderness, and Oak Creek Canyon where other management tool like prescribed burning or prescribed cutting have not been applied.

Overall, under this alternative, vegetation is expected to become only moderately departed after 15 years under the high treatment objective. Under the low treatment objective, the vegetation condition of this ERU is expected to remain highly departed but better than the current condition. Under both treatment objectives, vegetation would continue trending toward the desired conditions over the next 50 years. Regardless of the treatment objective, fire return interval departure is expected to remain high, while slowly trending toward the desired conditions. Vegetation and fire return interval departure may further improve by managing additional wildfires to meet resource objectives.

Alternative C

This ERU occurs in 18 different proposed management areas (Anderson Mesa, Blue Ridge, East Clear Creek, Flagstaff Neighborwoods, Hospital Ridge, Jack's Canyon, Limestone Pasture, Long Valley, Mount Elden, Oak Creek Canyon, Pine Belt, Pine Grove, Red Rock, San Francisco Peaks, Second Chance, Verde Valley, Volcanic Woodlands, and Walnut Canyon) under alternative C. The majority (72 percent) occurs within Pine Belt (46 percent), Long Valley (20 percent), and Anderson Mesa (6 percent). Approximately 4,462 acres of ponderosa pine (approximately 0.6 percent of the total ERU) are proposed for wilderness under this alternative, the vast majority of which is already unsuitable timberlands. This alternative differs from alternative B (modified) in that an additional 4,365 of ponderosa pine acres are proposed for wilderness under this alternative. If designated by Congress, the wilderness areas would be managed according to applicable laws, policy and forest plan direction. Law, regulation, and policy typically limits mechanical treatments in wilderness and the lack of treatments would move ponderosa pine away from vegetation and fire desired conditions over the long term in seven of the recommended wilderness areas (Abineau (68 acres), Barbershop (849 acres), Deadwood Draw (245 acres), East Clear Creek (1,240 acres), Railroad Draw (1,205 acres), Strawberry Crater (29 acres), and Tin Can (826 acres). There would be an increased risk of uncharacteristic fire, higher than desired fire severity, and a decreased likelihood of restoring natural fire interval in fire-adapted ERUs in these recommended wilderness areas. The scale of this impact varies by wilderness with the greatest impacts in East Clear Creek, Railroad Draw, Barbershop, and Tin Can recommended wilderness areas.

Departure and trend from reference condition:

Alternative C was modeled in the same way as alternative B (modified). Despite the removal of the additional acreage proposed for wilderness from the areas that may be treated under this model, the outcome is the same as in alternative B (modified). Given that the recommended wilderness footprint represents only a fractional proportion of the total ERU, there may be some wilderness-specific differences in outcomes, but overall, the differences at the ERU level in the outcome are negligible. See the old-growth discussion earlier in the Environmental Consequences section for additional differences with regard to old-growth allocations and the ability to achieve the desired distribution of vegetation states.

Alternative D

Alternative D differs from alternative B (modified) in that no new wilderness areas are proposed beyond those that are under the current plan.

Departure and trend from reference condition:

Given that the recommended wilderness footprint under alternative B (modified) represents only a fractional proportion of the total ERU, it is expected that the consequences under alternative D would still be similar to those of alternative B (modified).

Mixed Conifer with Frequent Fire

Alternative A

This ERU is within 12 different MAs under the 1987 plan; the majority (89 percent) falls in MA 3- Ponderosa Pine and Mixed Conifer less than 40 percent, MA 4- Ponderosa Pine and Mixed Conifer greater than 40 percent, and MA 19- Mogollon Rim. The existing forest plan provides little direction on desired conditions for this ERU as it is lumped into the broad vegetation category of Mixed Conifer, which is combined with ponderosa pine on slopes less than 40 percent or on slope greater than 40 percent. There is vague direction with regards to the mixed conifer category as a whole and is particularly ambiguous with respect to how structure, patterns, and function vary at different spatial scales (1987 Plan, pages 117,125,133,138). Specific direction is provided only as it relates to species habitat requirements (see Mexican spotted owl and northern goshawk discussion below).

There is direction to conform to the Mexican Spotted Owl Recovery Plan (1987 Plan, page 64). However, species recovery plans may be revised over the life of a forest plan. Currently, under alternative A, language from an earlier version of the Recovery Plan is integrated into the 1987 Plan and is in conflict with the most current recovery plan recommendations, does not reflect current science, and could be in conflict with future recovery plan revisions. For example, the language that was integrated into the current forest plan refers to “protected habitat” and “restricted habitat” which are outdated terms that are no longer used (1987 Plan, page 65). Furthermore, the current recovery plan recognizes that stand-replacing wildfires are the greatest threat to Mexican spotted owl habitat and does not recommend diameter caps (USDI Fish and Wildlife Service 2012b). There is a 9-inch d.b.h. limitation on tree cutting in most protected activity centers and on steep slope protected habitat for fire risk abatement in the current forest plan (1987 Plan, page 65-2, 65-3). This diameter cap is not as effective as other approaches in reducing the risk of fire and is not considered to be a valid approach for promoting and sustaining Mexican spotted owl habitat. Harvest activities, are limited and only fire risk abatement treatments and some fuelwood harvests are permitted in protected habitat. As a consequence of this direction and the associated treatment limitations (1987 Plan, pages 65; 65-2 to 65-4), past treatments prescribed under the existing Forest Plan have been too conservative to either maintain the desired age and structural diversity or to abate fire risk. Rather, treatments have tended to leave unnecessarily high stocking densities which increase the risk of uncharacteristically severe wildfires in this ERU.

The existing plan’s focus on commodity production, dwarf mistletoe eradication, and fire suppression within this vegetation type may hinder the restoration process, but it does not necessarily prevent attainment of the proposed desired conditions. Outside of protected habitat, the range of vegetation treatments is not as limited.

Fire treatment using prescribed fire and wildfires managed to meet resource objectives may be used, but there is no provision for using wildfires to meet resource objectives in the wildland-urban interface (1987 Plan, pages 92, 111, and 137). Furthermore, annual average wildfire acreage burned should not exceed 750 acres per year on the average over a 10-year period in MAs 3 and 4 (1987 Plan, page 137). These limitations to the role of fire in the ecosystem were designed to protect ponderosa pine suitable timberlands, but they also serve to inhibit the restoration of this ERU. The objectives of prescribed fire outside of the wildland-urban interface are to meet resource objectives, while protecting life and property, and protecting private in-holdings and other landownership (1987 Plan, page 94). The suppression objective is to minimize impact on the land while keeping fires to 10 acres or fewer in areas mapped as the wildland-urban interface (1987 Plan, pages 93,155, and 165). In areas outside the wildland-urban interface, the suppression objective is to minimize cost and provide for personnel safety while holding fires to 100 acres or less (1987 Plan, pages 94 and 137).

Additional direction for Mexican spotted owl and northern goshawk habitat provide specific direction to use prescribed fire and managed wildfires (referred to as “prescribed natural fire”) to meet resource objectives (1987 Plan, pages 65-2 to 65-4; 65-9). However, in many cases, the existing structure is too dense and layered and pre-treatment is required to achieve desired fire behavior.

Departure from Reference Conditions and Trend:

This ERU is currently moderately departed and trending away from the desired conditions for vegetation. The ERU is highly departed with respect to fire return interval, but trending very slowly toward the desired conditions. As discussed above, the desired conditions, where they are expressed in terms of a distribution of vegetation states, are not intended to be, nor should they be considered as outcomes at fine and mid scales. The desired vegetation distribution is a long-term target evaluated exclusively at very large landscape scales (specifically at the full extent of the ERU). At any one time, the distribution is expected to depart substantially at the stand scale and even at the scale of entire watersheds.

Under alternative A, the expected treatments would be the same as the low treatment level of alternatives B (modified), C and D, and would generally decrease tree density in the vegetation states that are currently overrepresented. Small trees would be removed and medium to large trees that occur in a closed state would be converted to an open state that more closely approximates the regionally consistent desired condition for restored mixed conifer forests with frequent fire (table 23). In some cases, mechanical treatment may be required before the historic fire regime could be reintroduced without compromising the residual vegetation. However, over the long term (50 years), the positive trend relative to vegetation departure would become static as treatment levels would not be able to keep up with growth and regeneration; seedlings and saplings would make gains through excess regeneration where openings are created and medium and large trees would lose ground in open stands as canopy gaps are filled in.

Within this ERU, areas where higher tree density is maintained, such as within protected Mexican spotted owl habitat, the risk of uncharacteristic fire is still higher than elsewhere. Early seral species, such as aspen, may continue to decline where late seral species or closed canopy conditions are emphasized. Outside of these areas, the ERU would generally be managed as Mexican spotted owl restricted habitat with an emphasis on large trees, large hardwoods, large snags, and large downed woody debris (1987 Plan, pages 65 to 65-6; 65-9 to 65-11).

While prescribed fire and wildfires may be managed to meet resource objectives, under this alternative, wildfires within the wildland-urban interface must be suppressed rather than managed for resource objectives (1987 Plan, page 137). Where wildfires are permitted to function in their natural roles, appropriate open conditions would be maintained, essential nutrient cycling would occur, and age class diversity would be promoted. In the short term, maintenance of open conditions would slow encroachment of trees. In the long term, fire intervals that are closer to desired conditions would also encourage subdominant species such as aspen and Gambel oak. Any restriction on the natural role of fire would slow the pace at which desired conditions can be achieved and would increase the risk of uncharacteristic wildfires near communities and infrastructure.

The following tables are based on a series of treatment projections. These are not treatment objectives since alternative A does not have any. Rather, these projections were developed based on the number of acres mechanically treated over the past decade.

- Use prescribed cutting to treat 2,900 acres of Mixed Conifer with Frequent Fire during each 10-year period over the life of the plan.
- Use prescribed fire on at least 8,000 acres of Mixed Conifer with Frequent Fire within the natural fire regime during each 10-year period over the life of the plan.
- Use naturally ignited wildfires (i.e., lightning-caused fires managed for resource objectives) to treat at least 7,500 acres of Mixed Conifer with Frequent Fire within the natural fire regime, during each 10-year period over the life of the plan.

Over the next 15 years, there are similar positive trends in the suitable and unsuitable timberlands (table 27). Appendix F compares the modeled outputs for suitable and unsuitable timber lands in more detail. There is movement toward desired conditions in States H, I, L, and M, which are dominated by medium and very large trees with closed canopies and multi-storied (uneven-aged) structure as well as in States D, E, J, and K which are more open. In unsuitable timber, the gains are somewhat less pronounced as a result of fewer timber management options and differing management objectives. After 50 years, the departure differences between suitable and unsuitable timber become greater, particularly as very large trees in open multistoried stands (State K) become for more common in suitable timber lands.

Table 27. Alternative A departure in suitable and unsuitable timberlands over time in Mixed Conifer Frequent Fire ERU

Alternative A Suitability	Initial Departure	Post-Treatment Departure	
		15 Year	50 Year
Suitable Timber	64%	42%	38%
Unsuitable Timber	63%	42%	49%
Combined	64%	42%	42%

Across suitable and unsuitable lands (table 28), grass, forb, brush/shrub/seedlings/saplings (States A, B, F, and N) are indicative of early stand development and of even-aged stand dynamics. This grouping of states is projected to move away from the desired condition after the first 15 years and continue to move away after 50 years. States A and N represent openings that are at the mid-scale (100 to 1,000 acres), and are not generally desired within this ERU. The grass, forb, and brush/shrub states (A and N) are attributed to larger than desired openings being created, primarily by wildfires (with undesired effects) and the resulting longer time period required to move back into a forested state. It is important to note that the desired openings for grass, forb, and shrub understory vegetation are built into open single storied states and throughout the multistoried states, but are not identified separately. States B and F represent seedlings and saplings and the increases seen here are attributed to tree growth and regeneration exceeding the number of acres being treated within the analysis period. Much of the ERU is located on steep slopes, inaccessible terrain, or in areas where vegetation is being managed for Mexican spotted owl and limitations are placed on harvest treatments; these factors at least partially, reduce the overall feasibility of treatment. Due to competitive interaction, seedlings and saplings start to stagnate and move mostly from State B to F or from state F into the closed small tree stage (State G). The relative proportion of these states remains higher than is desired conditions for this ERU. Vegetation conditions, particularly in seedlings and saplings, may improve by managing wildfires for resource objectives, but this option is not available within wildland-urban interface under alternative A.

Small, open canopy trees (State C) are projected to trend away from desired conditions after 15 years as canopies close and increasing competition reduces growth. Small open trees are transitioning to the small closed canopy tree state and not being replaced rapidly enough by seedlings and saplings which are slow to advance larger states because of competition and slow growth. When transition of seedlings and saplings into the small trees states does occur, it is primarily under closed canopy conditions. The trend in State C is projected to remain departed, over the next 50 years (table 28).

States D, E, J, and K, make up the vast majority of the desired distribution. It is important to note that States J and K are both multi-storied (uneven-aged) and have at least three age classes represented, including adequate openings for planned regeneration immediately after treatment. Although a state is described as “medium” or “very large” trees, it should be inferred that trees of other sizes and ages are also present. For example, State J is dominated by 10- to 20-inch d.b.h. trees, but it would also include a more or less balanced representation of seedlings/saplings, small trees, and some very large trees since it represents a multi-storied, uneven-aged state.

States D, E, J, and K are projected to make substantial progress toward the desired conditions by nearly tripling their occupied area within 15 years. This progress is attributed to treatments creating more open canopy conditions and providing for greater movement of the small tree states into larger tree states, while also creating more uneven-aged stand conditions. The trend toward desired conditions is primarily the result of treatments in suitable timberlands (appendix F). Eventually tree growth within these states would exceed the number of acres treated and as a result there is slower movement toward the desired condition between year 15 and 50.

Table 28. VDDT modeled output for Mixed Conifer with Frequent Fire ERU under alternative A on both suitable and non-suitable timberlands combined

State	Description	Desired %	Current %	Year 15	Year 50
A	A – Grass, Forb, Brush/Shrub		0.2	0.4	0.5
B	B – Seedling, Sapling, Open, SS_1		0.0	0.2	0.6
F	F – Seedling, Sapling, Closed, SS	9.0	0.0	11.3	23.1
N	N – Grass, Forb, Brush/Shrub Resulting from uncharacteristic Fire (delayed recovery time).		0.2	1.8	1.8
	Sub-total (A,B,F,N):		0.4	13.7	26.0
C	C - Small Trees, Open, SS	3.0	1.0	0.4	0.6
D	D – Medium Trees, Open, SS	60.0	2.0	2.3	1.1
E	E – Very Large Trees, Open, SS		0.0	0.9	2.1
J	J – Medium Trees, Open, MS_2		4.4	8.2	4.7
K	K – Very Large Trees, Open, MS		0.6	9.3	12.0
	Sub-total (D,E,J,K):		7.0	20.7	19.9
G	G - Small Trees, Closed, SS	3.0	9.7	6.5	10.3
H	H – Medium Trees, Closed, SS	25.0	21.6	12.2	5.4
L	L – Medium Trees, Closed, MS		49.8	30.4	17.4
I	I – Very Large Trees, Closed, SS		3.0	5.0	5.6
M	M –Very Large Trees, Closed, MS		7.6	11.1	14.7
	Sub-total (A,B,F,N):		82.0	58.7	43.1
	Level of Departure[3]:	0%	64%	42%	42%

1 SS = Single story (Even-aged).

2 MS = Multiple Story (Uneven-aged).

3 Departure Levels = High (>66%), Moderate (34-66%), and Low (0-33%).

Across the landscape, closed canopy conditions would still dominate this ERU and contribute to an underdeveloped understory layer, reduced growth rates of trees, an overall maintenance of even-aged structure, and a greater relative risk of uncharacteristic fires than under action alternatives. Prescribed fires and wildfires managed for resource objectives could maintain open conditions across the full mixed conifer with frequent fire landscape if permitted. Among other things, fire removes overrepresented seedlings and saplings that could eventually grow into the overstory effectively undoing the effects of previous mechanical treatments. Direction under alternative A prohibits managing wildfires to meet resource objectives in wildland-urban interface (1987 Plan, page 137). This can result in slower progress toward the desired conditions, particularly near high value resources (e.g., communities and infrastructure) that are at risk of uncharacteristic wildfires.

Small trees with closed canopy (State G) are projected to initially decrease, approaching but then moving away from the desired condition after 15 years. Thinning treatments initially increase the growth rate and allow small trees to move into the medium-sized tree states. After 15 years, the trend moves away. This is attributed to the growth of seedlings and saplings into this size class as well as the movement of small trees from open (State C) to closed canopy conditions. Canopy closure continues to increase, slowing tree growth and movement into the next size class. The number of acres treated, which would create open canopies that allow for more rapid diameter growth into larger tree states, is insufficient to reverse the trend.

States H, L, I, and M, which are indicative of mature closed forest habitat and occasional even-aged dynamics, trends toward desired conditions after 15 years as medium and large-sized trees under closed

canopy conditions move into open canopy states and uneven-aged structure. State I contains primarily very large trees and is described as single-storied (even-aged), but may also contain up to one other distinct size/age class and scattered single trees of different sizes. After 50 years the trend for this group of closed canopy states continues toward desired conditions, falling from almost 59 percent down to 43 percent of the ERU, but the level of departure is still well away from desired conditions.

In the existing Forest Plan a ponderosa pine/mixed conifer snag is defined as a tree greater than 12 inches d.b.h. and 15 feet tall, and a minimum should be maintained at an average of 200 snags per 100 acres across 50 percent of the forested landscape (1987 Plan, page 126). Snag requirements for old growth mixed conifer are a minimum of 2.5 trees per acre that are 20 feet tall and 14 inches d.b.h. (low site) or 25 feet tall and 16 inches d.b.h. (high site). In Mexican spotted owl restricted habitat, an unspecified, but "substantive" number of snags 18 inches d.b.h. and larger should be retained (1987 Plan, page 65-5). In landscapes outside goshawk post-fledging family areas, at least 3 snags (defined as 18 inches d.b.h. or larger and 30 feet high or larger) should be present (1987 Plan, pages 65-9 and 10). Under alternative A, snags of various sizes would be present across the landscape (table 29), adding complexity to forest structure and providing habitat components for multiple species. The numbers of snags are expected to remain static or increase.

Table 29. Predicted snag density by size class in Mixed Conifer with Frequent Fire under alternative A

	8 to 12 inches d.b.h.	12 to 18 inches d.b.h.	18+ inches d.b.h.
Existing	8.0	4.5	3.3
15 years	9.1	5.1	6.8
50 years	8.8	4.6	6.4

While alternative A does not have specific treatment objectives, it was analyzed based on a predicted range of treatment levels described above. The model used to develop the preceding predictions assumed that mechanical treatments, prescribed fire treatments, and wildfires managed for resource objectives would all occur over the life of the plan. Alternative A places additional restrictions on the location of wildfires managed for resource objectives. Although the extent and location of wildfires cannot be predicted, it is still reasonable to assume that under this alternative they may occur in areas where the use of this management tool is prohibited. A considerably smaller proportion of this ERU is within wildland-urban interface as compared to the ponderosa pine ERU. Nevertheless, opportunities to restore the historic fire regime and meet vegetation objectives may be missed. While other types of treatment may be used in these areas, if these areas left untreated because of these plan components are more likely to experience uncharacteristic fires and as a result, may experience greater than desired severity, soil impairment, and create greater threats to surrounding communities.

Generally, as a greater proportion of the Mixed Conifer with Frequent Fire ERU is made up of uneven-aged states, it would become more structurally diverse. Understory vegetation is also expected to respond favorably to treatment. As the amount of open canopy in the ERU increases over the next 50 years, conditions would favor a greater diversity of grasses, forbs, and shrubs which in turn supports a wider variety of wildlife species. The vegetation departure trend for the Mixed Conifer with Frequent Fire ERU under this alternative moves toward desired conditions, but still remains moderately departed after 15 years. The trend becomes static and remains moderately departed through 50 years. Since the expected treatment levels are too low to offset excess regeneration and small tree growth, seedlings, saplings, and small trees would continue on a negative trajectory and the initial positive trend would not be sustained over the long term. Movement of medium and larger sized trees, both closed and open canopy, would progress toward desired conditions, but canopy cover would remain predominantly closed across the

landscape inhibiting tree growth. A lack of clarity and specific desired conditions for this ERU in the current forest plan would continue to encourage an overly conservative approach to treatments. So, while some improvement would be made toward overall ecosystem health, there would continue to be a greater proportion of even-aged, closed canopy forest than is desired. Fire return interval is expected to remain highly departed, but trending very slowly toward desired conditions.

Alternative B (modified)

This ERU occurs in seven proposed management areas (Volcanic Woodlands, Pine Belt, San Francisco Peaks, Flagstaff Neighborwoods, Red Rock, Long Valley, East Clear Creek, and C.C. Cragin Watersheds) under alternative B (modified). The majority (79 percent) occurs within East Clear Creek (40 percent) and C.C. Cragin Watersheds (39 percent). Alternative B (modified) clearly distinguishes between different Mixed Conifer types on the forest and provides desired conditions, objectives and guidance that are specific to the each type. Other than the management direction that applies to all terrestrial ERUs (FW-Eco-DC-1 to 4; FW-TerrERU-All-DC-1 to 5; FW-TerrERU-All-S-1 to 4; FW-TerrERU-All-G-1 to 4) and that which is specific to this ERU (FW-TerrERU-MC-All-DC-1, 2, 3; FW-TerrERU-MC-MCFF-DC-1 to 12; FW-TerrERU-MC-MCFF-O-1, 2, 3; FW-TerrERU-MC-All-G-1, 2, 3), additional recommendations with regard to structure and composition, where applicable, are provided by reference to the Mexican Spotted Owl Recovery Plan (FW-WFP-G-1).

Under alternative B (modified) treatments within this ERU are somewhat less restricted than under alternative A (FW-Fire-G-1, 2; FW-TerrERU-All-G-1, 2; FW-TerrERU-MC-All-DC-1, 2, 3; FW-TerrERU-MC-MCFF-DC-1 to 12; FW-TerrERU-MC-All-G-1, 2, 3). The proposed guidance under this alterative would ensure that treatments achieve conditions that are regionally consistent and more accurately represent the best available science and the historic composition, structure, and functions of this ERU. There would be a greater emphasis on promoting an uneven aged structure that provides for long-term sustainability and contains old growth components across the entire landscape in the distribution and arrangement that they historically occurred (FW-TerrERU-MC-All-DC-1, 2, 3; FW-TerrERU-MC-MCFF-DC-1, 2, 4, 6, 7, 10, 11; FW-TerrERU-MC-All-G-1, 3). MSO Recovery Plan language is not explicitly integrated into the forest plan language (as it was under alternative A); however plan components that provide for Mexican spotted owl habitat are integrated into the mixed conifer ERUs (FW-TerrERU-MC-All-DC 1, 2, 3; FW-TerrERU-MC-MCFF-DC-1, 2, 3, 4, 6, 7, 8, 12; FW-TerrERU-MC-MCIF-DC-1,2,3,6; and FW-TerrERU-MC-All-G-1, 2, 3). The recovery plan is referred to in a guideline (WFP-G-1). This ensures that forest plan direction points to the most current recovery plans for different species including Mexican spotted owl.

Under this alternative, clear direction is provided with regard to desired conditions at multiple scales including structure, composition, tree density ranges, and the proper role of disturbance agents like fire and insects. This direction would ensure that any treatments within this ERU would maintain or move the area toward the desired conditions.

Departure and trend from reference condition:

Under alternative B (modified), the expected treatments would generally decrease tree density in the vegetation states that are currently overrepresented. Small trees would be removed and medium to large trees that occur in a closed state would be converted to an open state that more closely approximates the regionally consistent desired condition for restored mixed conifer forests with frequent fire (table 31). In those areas that require pre-treatment, the historic fire regime would be able to be reintroduced without compromising the residual vegetation after mechanical treatment is complete. This is essentially the same outcome as what would be achieved under alternative A, except that under the high treatment objective, the magnitude of the improvement would be greater (and also greater than the low treatment objective of

alternative B (modified). As a result of these changes in tree structure and composition, the diversity and distribution of understory vegetation are expected to increase where open stand conditions are created.

Over the long term (50 years), the trend becomes static relative to the desired conditions. In comparison to alternative A, which is the same as the low treatment objective, larger gains are made under the high treatment objective of this alternative in converting the medium and very large trees in closed canopy states (H, I, L, and M) to open canopy states (D, E, J, and K). However, even at these higher treatment levels, vegetation management activities would not be able to keep up with regeneration. Seedling and saplings would make gains through excess regeneration where opening are created; as densities increase within these states, growth from saplings into small tree states would remain commensurately slow.

A desired condition for mixed conifer types is to have a mosaic of trees with varying age classes and understory vegetation that provide habitat for wildlife species, including Mexican spotted owls and northern goshawks; ground cover for functional soil and watersheds; and fuel for fire to occur according to historic ranges of frequency and severity (FW-TerrERU-MC-DC-1). In localized areas where higher tree density is maintained, such as north-facing slopes and canyon bottoms (FW-TerrERU-MC-MCFF-DC- 1,6), within Mexican spotted owl PACs, and in northern goshawk post-fledging areas (FW-TerrERU-MC-MCFF-DC-9), the risk of uncharacteristic would be higher than elsewhere. Early seral species, such as aspen, may continue to decline where late seral species or closed canopy conditions are emphasized. Outside of these areas, the ERU would generally be managed for a more open canopy uneven-aged forest structure, with large trees, large hardwoods, large snags, and large downed woody debris represented throughout (FW-TerrERU-MC-MCFF-DC-1, 6).

Under alternative A, wildfires managed to meet resource objectives are not permitted in the wildland-urban interface (1987 Plan, page 137); however, under alternative B (modified) there are no such restrictions (FW-WUI-DC-4). Where wildfires function in their natural roles, appropriate open conditions could be maintained, essential nutrient cycling would occur, and age class diversity would be promoted. In the short term, maintenance of open conditions would slow the encroachment of trees. In the long term, fire return intervals that are closer to desired conditions would also encourage species such as aspen and Gambel oak. In vegetation states where the canopy is closed (State G), alternative B (modified) would permit a beneficial use of wildfire and foster an increase in the rate of small tree diameter growth by reducing the density of subdominant trees. This would move the remaining small trees into the larger tree states and toward desired conditions at a faster rate than alternative A.

Unlike under alternative A, which does not have specific treatment objectives, under alternative B (modified), there are three identified treatment objectives (FW-TerrERU-MC-MCFF-O-1,-3). These objectives are defined by treatment ranges that, on the low end, were based upon the number of mechanically treated acres on the forest over the past decade and on the high end, were based on an estimate of the number of treated acres required to make measurable improvements to vegetation departure.

- Use prescribed cutting to treat 2,900 to 15,000 acres of Mixed Conifer with Frequent Fire during each 10-year period over the life of the plan.
- Use prescribed fire on at least 8,000 acres of Mixed Conifer with Frequent Fire within the natural fire regime during each 10-year period over the life of the plan.
- Use naturally ignited wildfires (lightning-caused fires managed for resource objectives) to treat at least 7,500 acres of Mixed Conifer with Frequent Fire within the natural fire regime, during each 10-year period over the life of the plan.

Movement toward desired conditions is a function of the number of acres treated. The more acres treated, the greater the movement toward desired conditions (table 31). Under the high treatment objective of this

alternative, 15,000 acres are proposed during each 10-year period over the life of the plan (approximately four times as many as under the low objective and under alternative A) and vegetation departure would be reduced to low within 15 years. After a substantial initial gain, the rate of change would level off dramatically between years 15 and 50. Under the low treatment objective, the number of acres is the same as under alternative A. As such, the outcome would be similar with initial improvements that are less dramatic than those under the high treatment objective, followed by a reduction in the rate of change. Vegetation conditions may further improve by managing additional wildfires to meet resource objectives.

Timber management may occur on unsuitable lands, but is driven by other resource objectives such as, wildlife habitat improvement or fire regime restoration. The only unsuitable lands modeled for this report were Mexican spotted owl protected activity centers (PACs), which were thinned from below up to 9 inches d.b.h. to reduce wildfire risk; though under alternative B (modified) larger trees may also be removed when appropriate and in consultation with the Fish and Wildlife Service. Under the high treatment objective, the greatest movement toward desired conditions and reduction of vegetation departure occurs on suitable timberlands, which achieve nearly 3 times as much improvement as is seen on the unsuitable timber lands (table 30). After 50 years of treatments, the vegetation condition on unsuitable lands still does not reach low levels of departure (in suitable timber, low departure is achieved within 15 years). Under the low treatment objective, there are some initial gains, but there is little difference between suitable and unsuitable timberlands until year 50. Between 15 and 50 years, vegetation departure in suitable timberlands would continue to slowly decline (achieving moderate departure), while unsuitable timberlands would remain moderately departed and trend away from desired conditions. Regardless, under the low treatment objective, a low level of departure is never achieved.

Appendix F compares the modeled outputs for suitable and unsuitable timber lands in more detail. Under both the low and high treatment objectives, positive trends toward desired conditions are seen in States D, E, J and K within the suitable timberlands. These states are dominated by medium and very large trees with open canopies and multi-storied (uneven-aged) structure. Under the both the low and high treatment objective, initial gains persist over the long term, but the gains under the high treatment objective are far more substantial. Similarly, there is greater movement toward the desired condition for closed canopy states with medium and very large trees (H, L, I, M) under the high treatment objective than under the low treatment objective. Most movement is toward states J and K or D and E (see appendix F). Unsuitable timberlands experience similar positive trends in most states, but they are not as pronounced as on suitable timberlands due to differing management requirements and a related reduced in timber management options. Under both the low and high treatment objectives, positive trends toward desired conditions are seen in States D, E, J and K, which are dominated by medium and very large trees with open canopies and multi-storied (uneven-aged) structure; however, under the low treatment objective, short-term gains are lost over the long term. Under the high treatment objective, initial gains are more moderate but persist over the long term. Closed canopy states for medium and very large trees (H, L, I, M) are set on a positive trend, with most moving to states J and K or D and E (see appendix F).

Table 30. Effects of different treatment levels on the amount of vegetation departure within suitable and unsuitable areas in Mixed Conifer with Frequent Fire for alternatives B (modified), C, and D

Suitability	Initial Departure	Low Objective		High Objective	
		15 Yr	50 Yr	15 Yr	50 Yr
Suitable Timber	64%	42%	38%	21%	16%
Unsuitable Timber	63%	42%	49%	49%	48%
Combined (Suitable and Unsuitable Timber)	64%	42%	42%	33%	29%

Grass, Forb, Brush/Shrub/Seedlings/Saplings (States A, B, F, and N) are indicative of early stand development and of even-aged stand dynamics. Under both the low and high treatment objectives (table 31), this grouping of states is projected to move away from the desired condition after the first 15 years and continue to move away after 50 years; though in the long term, the vegetation condition is less departed under the high treatment objective. States A and N represent openings that are at the mid-scale (100 to 1,000 acres), and are not generally desired within this ERU. It is important to note that the desired openings for grass, forb, and shrub understory vegetation are built into open single-storied states and throughout the multistoried states, but are not identified separately. The continued increase in the grass, forb, and brush/shrub state is attributed to larger than desired openings being created, primarily by wildfires (with undesired effects) and the resulting longer time period required to move back into a forested state.

Table 31. VDDT modeled output for Mixed Conifer with Frequent Fire ERU on suitable and non-suitable timberlands combined for alternatives B (modified), C, or D

State	Description	Desired %	Current %	Low Objective		High Objective	
				Year 15 %	Year 50 %	Year 15 %	Year 50 %
A	A – Grass, Forb, Brush/Shrub	9.0	0.2	0.4	0.5	0.4	0.5
B	B – Seedling, Sapling, Open, SS1		0.0	0.2	0.6	0.3	0.5
F	F – Seedling, Sapling, Closed, SS		0.0	11.3	23.1	11.6	19.9
N	N – Grass, Forb, Brush/Shrub Resulting from uncharacteristic fire (delayed recovery time).		0.2	1.8	1.8	1. 2	1. 7
Sub-total (A,B,F,N):			0.4	13.7	26.0	13.5	22.6
C	C - Small Trees, Open, SS	3.0	1.0	0.4	0.6	0. 3	0. 5
D	D – Medium Trees, Open, SS	60.0	2.0	2.3	1.1	1.8	0.7
E	E – Very Large Trees, Open, SS		0.0	0.9	2.1	0. 8	1. 3
J	J – Medium Trees, Open, MS2		4.4	8.2	4.7	9.9	4. 1
K	K – Very Large Trees, Open, MS		0.6	9.3	12.0	17.3	27. 1
Sub-total (D,E,J,K):			7.0	20.7	19.9	29.8	33.2
G	G - Small Trees, Closed, SS	3.0	9.7	6.5	10.3	7.2	9.3
H	H – Medium Trees, Closed, SS	25.0	21.6	12.2	5.4	9.5	3.5
L	L – Medium Trees, Closed, MS		49.8	30.4	17.4	24.7	11.9
I	I – Very Large Trees, Closed, SS		3.0	5.0	5.6	4.1	3.7
M	M –Very Large Trees, Closed, MS		7.6	11.1	14.7	10.8	15.3
Sub-total (H,L,I,M):			82.0	58.7	43.1	49. 1	34. 4
Level of Departure[3]:		0%	64%	42%	42%	33%	29%

[1] SS = Single story (Even-aged).

[2] MS = Multiple story (Uneven-aged).

[3] Departure Levels = High (>66%), Moderate (34-66%), and Low (0-33%).

States B and F represent seedlings and saplings and the increases seen here under both high and low treatment objectives are attributed to tree growth and regeneration exceeding the number of acres being treated within the analysis period. Much of the ERU is located on steeper slopes, inaccessible terrain, or in areas that have operational constraints associated with habitat protection such as timing restrictions in Mexican spotted owl PACs; these factors at least partially, reduce the overall feasibility of treatment or limit the types of treatments that might be possible. Due to competitive interaction, seedlings and saplings start to stagnate and move mostly from State B to F or from state F into the closed small tree stage (State G). The relative proportion of these states remains higher than is desired conditions for this ERU. Vegetation conditions, particularly in seedlings and saplings, may improve by managing wildfires for resource objectives (an option that is not permitted in wildland-urban interface under alternative A) or through prescribed cutting and burning. These treatments reduce the density of seedlings and saplings which would increase the growth rate.

Under both the low and high treatment objective, small, open canopy trees (State C) are projected to trend away from desired conditions after 15 years as canopies close and increasing competition reduces growth. Small trees under open canopies are transitioning to the small closed canopy tree state (G) and are not being replaced rapidly enough by open grown seedlings and saplings. Seedlings and saplings under closed canopies are slow to advance to larger states because of competition and slow growth. When seedlings and saplings transition into the small trees states, it is primarily under closed canopy conditions. The trend for State C is projected to improve slightly after 50 years, but still remain departed.

States D, E, J, and K, make up the vast majority of the desired distribution. It is important to note that that States J and K are both multi-storied (uneven-aged) and have at least three age classes represented, including adequate openings for planned regeneration immediately after treatment. Although a state may be described as “medium” or “very large” trees, it should be inferred that trees of other sizes/ages are also present. For example, State J is dominated by 10- to 20-inch d.b.h. trees, but it would also include a more or less balanced representation of seedlings/saplings, small trees, and some very large trees since it represents a multi-storied, uneven-aged state.

These open canopy states (States D, E, J, and K) are projected to make substantial progress toward the desired conditions, increasing the area that they occupy in the next 15 years by 3 to 4 times the current conditions. The overall trend is the same under both the low and high treatment objectives, but the high treatment objective has a faster rate and makes nearly 30 percent more progress than either the low treatment objective or alternative A. This progress is attributed to treatments creating more open canopy conditions and providing for greater movement of the small tree states into larger tree states, while also creating more uneven-aged stand conditions. The trend toward desired conditions is primarily the result of treatments in suitable timberlands (appendix F). Nevertheless, in the long term, the number of acres treated under either the low or high treatment objective would not be able to offset tree growth within States D, E, J, and K, and as a result, there is slower movement toward the desired condition between year 15 and 50.

Under both the low and high treatment objectives, small trees with closed canopy (State G) are projected to initially decrease, approaching but then moving away from the desired condition after 15 years. Thinning treatments initially increase the growth rate and allow small trees to move into the medium-sized tree states. After 15 years, the trend moves away. This is attributed to the growth of seedlings and saplings into this small tree state as well as the movement of small trees from open (State C) to closed canopy conditions (State G). Canopy closure continues to increase, slowing tree growth and movement into the next size class. The number of acres treated, which would create open canopies that allow for more rapid diameter growth into larger tree states, is insufficient to reverse the trend.

States H, L, I, and M, which are indicative of mature closed forest habitat and occasional even-aged dynamics trends toward desired conditions after 15 years as medium and large-sized trees under closed canopy conditions move into open canopy states and uneven-aged structure. This is the case under both the low and high treatment objectives. However, the magnitude of the change is greater under the high treatment objective. State I contains primarily very large trees and is described as single-storied (even-aged), but may also contain up to one other distinct size/age class and scattered single trees of different sizes. After 50 years, the trend for this group of closed canopy states continues, falling from almost 59 percent to 43 percent of the ERU under the low treatment objective and from almost 49 percent down to 34 percent of the ERU under the high treatment objective. Nevertheless, the level of departure is still well away from desired conditions in either case.

Across the landscape, closed canopy conditions would still dominate this ERU in the short term and contribute to an underdeveloped understory layer, reduced growth rates of trees, an overall maintenance of even-aged structure, and a greater relative risk to uncharacteristic fires. Prescribed fires and wildfires managed to meet resource objectives are the only practical means by which to maintain this open condition across the full mixed conifer with frequent fire landscape. Among other benefits, fire removes overrepresented seedlings and saplings that could eventually grow into the overstory essentially negating the effects of previous mechanical treatments.

Grass, Forb, Brush/Shrub/Seedlings/Saplings (States A, B, F, and N) are indicative of early stand development and of even-aged stand dynamics. Under both the low and high treatment objectives (table 31), this grouping of states is projected to move away from the desired condition after the first 15 years and continue to move away after 50 years; though in the long term, the vegetation condition is less departed under the high treatment objective. States A and N represent openings that are at the mid-scale (100 to 1,000 acres), and are not generally desired within this ERU. It is important to note that the desired openings for grass, forb, and shrub understory vegetation are built into open single storied states and throughout the multistoried states, but are not identified separately. The continued increase in the grass, forb, and brush/shrub state is attributed to larger than desired openings being created, primarily by wildfires (with undesired effects) and the resulting longer time period required to move back into a forested state.

States B and F represent seedlings and saplings and the increases seen here under both high and low treatment objectives are attributed to tree growth and regeneration exceeding the number of acres being treated within the analysis period. Much of the ERU is located on steeper slopes, inaccessible terrain, or in areas that have operational constraints associated with habitat protection such as timing restrictions in Mexican spotted owl PACs; these factors at least partially, reduce the overall feasibility of treatment or limit the types of treatments that might be possible. Due to competitive interaction, seedlings and saplings start to stagnate and move mostly from State B to F or from state F into the closed small tree stage (State G). The relative proportion of these states remains higher than is desired conditions for this ERU. Vegetation conditions, particularly in seedlings and saplings, may improve by managing wildfires for resource objectives (an option that is not permitted in wildland-urban interface under alternative A) or through prescribed cutting and burning. These treatments reduce the density of seedlings and saplings which would increase the growth rate.

Under both the low and high treatment objectives, small, open canopy trees (State C) are projected to trend away from desired conditions after 15 years as canopies close and increasing competition reduces growth. Small trees under open canopies are transitioning to the small closed canopy tree state (G) and are not being replaced rapidly enough by open grown seedlings and saplings. Seedlings and saplings under closed canopies are slow to advance to larger states because of competition and slow growth. When

seedlings and saplings transition into the small trees states, it is primarily under closed canopy conditions. The trend for State C is projected to improve slightly after 50 years, but still remain departed.

States D, E, J, and K, make up the vast majority of the desired distribution. It is important to note that that States J and K are both multi-storied (uneven-aged) and have at least three age classes represented, including adequate openings for planned regeneration immediately after treatment. Although a state may be described as “medium” or “very large” trees, it should be inferred that trees of other sizes/ages are also present. For example, State J is dominated by 10- to 20-inch d.b.h. trees, but it would also include a more or less balanced representation of seedlings/saplings, small trees, and some very large trees since it represents a multi-storied, uneven-aged state.

These open canopy states (States D, E, J, and K) are projected to make substantial progress toward the desired conditions, increasing the area that they occupy in the next 15 years by 3 to 4 times the current conditions. The overall trend is the same under both the low and high treatment objectives, but the high treatment objective has a faster rate and makes nearly 30 percent more progress than either the low treatment objective or Alternative A. This progress is attributed to treatments creating more open canopy conditions and providing for greater movement of the small tree states into larger tree states, while also creating more uneven-aged stand conditions. The trend toward desired conditions is primarily the result of treatments in suitable timberlands (appendix F). Nevertheless, in the long term, the number of acres treated under either the low or high treatment objective would not be able to offset tree growth within these States D, E, J, and K and, as a result, there is slower movement toward the desired condition between years 15 and 50.

Under both the low and high treatment objectives, small trees with closed canopy (State G) are projected to initially decrease, approaching but then moving away from the desired condition after 15 years. Thinning treatments initially increase the growth rate and allow small trees to move into the medium-sized tree states. After 15 years, the trend moves away. This is attributed to the growth of seedlings and saplings into this small tree state as well as the movement of small trees from open (State C) to closed canopy conditions (State G). Canopy closure continues to increase, slowing tree growth and movement into the next size class. The number of acres treated, which would create open canopies that allow for more rapid diameter growth into larger tree states, is insufficient to reverse the trend.

States H, L, I, and M, which are indicative of mature closed forest habitat and occasional even-aged dynamics trends toward desired conditions after 15 years as medium and large-sized trees under closed canopy conditions move into open canopy states and uneven-aged structure. This is the case under both the low and high treatment objectives. However, the magnitude of the change is greater under the high treatment objective. State I contains primarily very large trees and is described as single-storied (even-aged), but may also contain up to one other distinct size/age class and scattered single trees of different sizes. After 50 years the trend for this group of closed canopy states continues, falling from almost 59 percent to 43 percent of the ERU under the low treatment objective, and from almost 49 percent down to 34 percent of the ERU under the high treatment objective. Nevertheless, the level of departure is still well away from desired conditions in either case.

Across the landscape, closed canopy conditions would still dominate this ERU in the short term and contribute to an underdeveloped understory layer, reduced growth rates of trees, an overall maintenance of even-aged structure, and a greater relative risk to uncharacteristic fires. Prescribed fires and wildfires managed to meet resource objectives are the only practical means by which to maintain this open condition across the full mixed conifer with frequent fire landscape. Among other benefits, fire removes overrepresented seedlings and saplings that could eventually grow into the overstory essentially negating the effects of previous mechanical treatments.

Under alternative B (modified), snags are typically 18 inches and above at d.b.h. and average 3 per acre. Snags are present as old growth components throughout the landscape (FW-TerrERU-MC-MCFF-DC-3) adding complexity to forest structure and providing habitat components for multiple species. Under both the low and high treatment objectives, the numbers of snags are expected to meet and exceed the desired conditions (table 32).

Table 32. Predicted snag density by size class in Mixed Conifer with Frequent Fire under alternatives B (modified), C, and D

	Low Objective			High Objective		
	8 to 12 inches d.b.h.	12 to 18 inches d.b.h.	18+ inches d.b.h.	8 to 12 inches d.b.h.	12 to 18 inches d.b.h.	18+ inches d.b.h.
Existing	8.0	4.5	3.3	8.0	4.5	3.3
15 years	9.1	5.1	6.8	8.9	5.1	7.1
50 years	8.8	4.6	6.4	8.6	4.7	7.0

The model used to develop the preceding predictions assumed that mechanical treatments, prescribed fire treatments, and wildfires managed to meet resource objectives would all occur over the life of the plan. Alternative A places additional restrictions on the location of wildfires managed to meet resource objectives that alternative B (modified) does not. Although the extent and location of wildfires cannot be predicted, it is still reasonable to assume that under alternative A, they may occur in areas where the use of this management tool is prohibited. A considerably smaller proportion of this ERU is within wildland-urban interface as compared to other ERUs such as ponderosa pine and pinyon juniper grassland, so the impact is not expected to be large. Nevertheless, opportunities to restore the historic fire regime and meet vegetation objectives may be missed in these areas under alternative A where they would not under alternative B (modified). As such, the likelihood of experiencing greater than desired fire severity, soil impairment, and threats to surrounding communities is lower under this alternative than under alternative A.

Generally speaking, as a greater proportion of the Mixed Conifer with Frequent Fire ERU is made up of uneven-aged states, it would become more structurally diverse. Understory vegetation is also expected to respond favorably to treatment. As the amount of open canopy in the ERU increases over the next 15 and then 50 years, conditions would favor a greater diversity of grasses, forbs, and shrubs which in turn supports a wider variety of wildlife species.

Under this alternative, the vegetation condition of the Mixed Conifer with Frequent Fire ERU achieves a low level of departure under the high treatment objective, but remains moderately departed under the low treatment objective. Under both treatment objectives, the initial trend is toward desired conditions, but in both cases the progress becomes static after 50 years. Since the expected treatment levels are too low to offset excess regeneration and small tree growth, seedlings, saplings, and small trees with closed canopy would continue on a negative trajectory and some initial grains would not be sustained over the long term. Under the high treatment objective, movement of medium and larger sized trees, both closed and open canopy, would progress toward desired conditions over the long term and eventually, closed canopy conditions would no longer dominate. This is a substantial improvement over the low treatment objective and over Alternative A which would continue to be dominated by closed canopy conditions even after 50 years. Additional clarity under the proposed language would also discourage the unnecessarily conservative approach to treatments under the current plan, thereby ensuring greater improvements to ecosystem health. Fire return interval is expected to remain highly departed, but trend very slowly toward desired conditions.

Alternative C

This ERU occurs in 11 different proposed management areas (Blue Ridge, East Clear Creek, Flagstaff Neighborwoods, Hospital Ridge, Knoll Lake, Limestone Pasture, Long Valley, Pine Belt, Red Rock, San Francisco Peaks, and Volcanic Woodlands) under alternative C. The majority (69 percent) occurs within Blue Ridge (28 percent), East Clear Creek (26 percent), and Long Valley (15 percent).

Alternative C clearly distinguishes between different Mixed Conifer types on the forest and provides desired conditions, objectives and guidance that are specific to the each type. This alternative differs from alternative B (modified) in that an additional 283 acres are proposed for wilderness (approximately 0.6 percent of the total ERU). If designated by Congress, the wilderness areas would be managed according to applicable laws, policy and Forest Plan direction (SA-Wild-DC; -O; -S; -G). This direction typically limits active vegetation management and may have negative consequences with respect to meeting the ERU's vegetation and fire desired conditions over the long term within the affected area.

Departure and trend from reference condition:

Alternative C was modeled in the same way as alternative B (modified). Despite the removal of additional acreage proposed for wilderness from the areas that may be treated under this model, the outcome under alternative C is expected to be the same as under alternative B (modified). Given that the recommended wilderness footprint represents only a fractional proportion of the total ERU, there may be some highly localized differences in outcomes, but overall the differences are negligible.

Alternative D

Alternative D does not differ from alternative B (modified).

Departure and trend from reference condition:

The consequences of this alternative are expected to be the same as those of alternative B (modified).

Pinyon-Juniper with Grass

Pinyon juniper forests, a key southwestern vegetation type, are clearly water-limited systems, and pinyon juniper ecotones are sensitive to feedbacks from environmental fluctuations and existing canopy structure that may provide trees a buffer against drought. However, severe multi-year droughts periodically cause dieback of pinyon pines, which may overwhelm local buffering (USDA Forest Service 2010a). The most recent dieback in 2003 was historically unprecedented in its combination of fire suppression, low precipitation, and high temperatures. Increased drought stress via warmer climate is the predisposing factor, and pinyon pine mortality and fuel accumulations are inciting factors. Ecosystem change may arise from large-scale severe fires that lead to colonization of invasive species, which further compromises the ability of pinyon pines to re-establish (USDA Forest Service 2010a). Both localized and widespread mortality events have occurred over time in the Pinyon Juniper Woodlands on the forest, typically being pinyon Ips outbreaks associated with periods of drought, such as occurred in the mid-1990s and 2001–2003 (Lynch et al. 2007). These outbreaks may actually serve to decrease tree densities that have encroached into the Pinyon Juniper with Grass; however, trees targeted by the beetle are likely to be larger pinyon pines that are desired within this ERU. Négron and Wilson (2003) found that high stand density levels of pinyon make stands more susceptible to pinyon ips infestations and that the proportion of killed trees increased with increasing size classes. Continued infestations could favor the seedling, sapling and small tree states, which would tend to move this ERU away from desired conditions.

Romme et al. (2009) state with high confidence that tree density and canopy coverage have increased substantially during the past 150 years in many pinyon and juniper woodlands, but have not changed or have declined in others, with former grasslands and shrublands in some regions being converted to savanna or woodland as trees have expanded into previously non-wooded sites. This statement holds true

within pinyon juniper grasslands and adjacent grasslands on the Coconino where tree encroachment has occurred as a result of fire regime disruption.

Alternative A

Current plan language:

This ERU is within 19 different management areas under the 1987 Plan; however, the majority (65 percent) is within MA 7 - Pinyon Juniper Woodlands less than 40 percent slope and, MA 10 – Grassland and Sparse Pinyon Juniper Above the Rim.

The existing forest plan provides little direction on desired conditions for this ERU, as it is lumped into the broad vegetation category of Pinyon Juniper. Management Areas 7 and 10 are made up of Pinyon Juniper Grasslands and Woodlands and emphasize the use of prescribed fire and mechanical treatments to achieve management objectives associated with range, watershed condition, and wildlife habitat (1987 Plan, pages 148-155; 162 to 165). Management Area 10 places more emphasis on prescribed burning and individual tree removal to achieve range improvements (1987 Plan, page 164). Management Area 7 provides direction to use mechanical treatment of vegetation, emphasizing management on a sustained-yield basis for firewood and miscellaneous convertible products (1987 Plan, pages 148; 169). Additional direction is provided for MA 7 regarding the slope ranges where different management objections should be focused. For example, old growth, cover, and snags are generally provided on slopes greater than 15 percent, while mechanical treatment should be managed on slopes less than 15 percent (1987 Plan, page 148). Silvicultural guidance is provided for shelterwood, clear-cutting and uneven-aged systems to manage between 30 and 60 percent cover in MA 7. The silvicultural systems recommended provide enough flexibility to move toward desired conditions; however, the direction to manage cover in Pinyon Juniper Grasslands would leave too much canopy cover across the landscape to return to the desired grassland state of this ERU.

Prescribed fire and wildfires managed for resource objectives may be used, but there is no provision for using wildfires managed for resource objectives in the wildland-urban interface (1987 Plan, page 92; pages 155, and 165). Prescribed fires outside the wildland-urban interface are intended to meet resource objectives, while also protecting life, property, private in-holdings, and other landownership (1987 Plan, page 94). The suppression objective is to minimize impact on the land while keeping fires to 10 acres or less in areas mapped as the wildland-urban interface (1987 Plan, page 93; pages 155 and 165). In areas outside the wildland-urban interface, the suppression objective is to minimize cost and provide for personnel safety while holding fires to 1,000 acres or less (1987 Plan, page 94; pages 155 and 165).

Departure and trend from reference condition:

The vegetation condition is currently moderately departed with a trend away from desired conditions. Fire return interval is moderately departed and trending away from the desired conditions. There are no treatment objectives under alternative A, and continued management at current levels would likely reinforce the current trend of increasing tree density and cover.

Under alternative A, the expected treatments would make some small gains with respect to reducing vegetation departure, but generally the treatment level is insufficient to offset the negative effects of excess regeneration and closing canopies in the long term (table 33). Open canopy, medium trees move toward the desired conditions, as do States B, C, and D which together form an uneven-aged multi-state group. The remaining states either increase departure or make short term improvements but then begin to depart again in the long term.

The following tables and discussion are based on a series of treatment projections. These are not treatment objectives because alternative A does not have any. Rather, these projections were developed based on the number of acres mechanically treated over the past decade.

- Mechanically treat 1,000 acres of Pinyon Juniper with Grass during each 10-year period over the life of the plan.
- Use naturally ignited wildfires (i.e., lightning-caused fires that are managed for resource objectives) to treat at least 3,750 acres of Pinyon Juniper with Grass within the natural fire regime during each 10-year period over the life of the plan.

Regionally consistent desired conditions for this ERU emphasize trees occurring as individuals, but occasionally in smaller groups, and ranging from young to old. Scattered shrubs and a dense herbaceous understory including native grasses, forbs and annuals are present to support frequent surface fires. Specifically, approximately half of the trees in the Pinyon Juniper grassland type should be medium sized trees growing in open canopy conditions. This is due, in large part, to the slower growth rates of pinyon pines and juniper and because trees greater than 20 inches diameter at root collar (d.r.c.), while a desired component, are still relatively rare across the landscape.

Table 33. VDDT modeled output for Pinyon Juniper Grassland ERU under alternative A

State	Description[1]	Desired %	Current %	Year 15 %	Year 50 %
A	Grass, Forb, Brush/Shrub	5.0	23.0	12.9	3.6
B	B – Seedling, Sapling, Open	25.0	16.0	9.1	3.5
C	C – Small Trees, Open		26.0	10.7	4.8
E	E – Very Large Trees, Open		17.0	11.0	4.5
Sub-total (B,C,E):			59.0	30.8	12.8
D	D – Medium Trees, Open	50.0	2.0	12.7	19.7
F	F – Seedling, Sapling, Closed	10.0	13.0	29.0	24.5
G	G – Small Trees, Closed	10.0	3.0	14.7	39.4
Level of Departure[2]:		0%	60%	42%	48%

[1] The combination of States B,C & E are uneven-aged. All other states are single storied (even-aged).

[2] Departure Levels = High (>66%), Moderate (34-66%), and Low (0-33%).

Grass, forb, brush/shrub (State A) is projected to move toward the desired condition after the first 15 years and then drop below after 50 years. This continued decline in the grass, forb, and brush/shrub state is attributed to tree growth and establishment exceeding the number of acres treated and maintained as openings.

Seedlings/saplings, small, and very large trees - open (States B, C, and E) are projected to approach the desired condition after 15 years and then drop below after 50 years. This decline is attributed to the amount of area moving from open to closed canopy states within these size classes, as evidenced by the sharp increase in States F and G. Growth declines as canopy cover and competition increases. Understory vegetation is expected to decrease in distribution and diversity as crown cover increases. Less sunlight would reach the forest floor, and availability of water and nutrients to understory plants would decline as tree cover increase. Treatments at the projected level, while realizing initial gains over the first 15 years, are unable to maintain the desired open conditions.

Medium trees with open canopies (State D), where the largest proportion of the ERU is desired, is projected to make substantial movement toward the desired condition after 15 years. This trend would continue through year 50, but at a much slower rate. Some movement of small trees into this size class would continue to occur, but slow growth rates and increasing closed conditions, combined with the relatively small number of acres treated annually, diminish the positive trend. Understory vegetation should experience a corresponding increase in both distribution and diversity.

Seedlings/saplings – closed (State F) is projected to increase, moving from slightly above the desired condition, to more than double the area currently occupied after 15 years. This negative trend is attributed to trees moving in from States B and C as canopies close. The trend begins to reverse back toward the desired condition after 50 years as trees grow into the next size class. Closed canopy conditions contribute to competition and slower growth rates of trees within this state, slowing movement into the next size class. Treatments do not occur at a level to substantially reduce the area occupied by trees in this state. Understory vegetation is expected to decline as tree canopies closes and limit the amount resources available (e.g., sunlight, water, nutrients).

Small trees – closed (State G) is projected to increase, reaching and then exceeding the desired condition after 15 years. This is attributed to growth of seedlings and saplings into this size class as well as movement of small trees from open to closed canopy conditions. After 50 years, the trend accelerates and moves farther away from the desired condition. Canopy closure continues to increase, slowing tree growth and movement into the next size class. Understory vegetation would suffer as the amount of area with closed canopy increases, shading out those species. The number of acres treated is insufficient to maintain area occupied at or near current levels or reverse the projected trend of continued expansion.

In the existing Forest Plan, a Pinyon Juniper snag is defined as being at least 9 inches d.r.c. and at least 10 feet high, and managed for at least an average of 1.0 snag per acre on 40 percent of the Pinyon Juniper Woodland acres in each 10,000-acre block (1987 Plan, page 153). Snag requirements for old-growth Pinyon Juniper are a minimum of 0.5 trees per acre that are 8 feet tall and at least 9 inches d.b.h. (low site) or an average of 1 snag per acre that is 10 feet tall and 10 inches d.b.h. (high site) (1987 Plan, page 70-2). While the number of snags is expected to fall just slightly short of the desired conditions with respect to the largest snags, the desired conditions for the total number of snags greater than 8 inches would be met (table 34). Conditions may be further improved through project-level design criteria focused on creating or retaining large snags.

Table 34. Predicted snag density by size class in Pinyon Juniper with Grass ERU under alternative A

	8 to 12 inches d.b.h.	12 to 18 inches d.b.h.	18+ inches d.b.h.
Existing	5.0	3.8	1.8
15 years	3.2	1.3	0.7
50 years	4.9	2.1	1.0

Based on the projected treatment levels, departure relative to the desired conditions for vegetation would see some improvement during the first 15 years (table 33). However, the number of acres treated annually would be insufficient to offset the negative impacts of excess regeneration and canopy closure. In the long term (50 years), the initial gains would be lost as seedlings, saplings, and small trees with closed canopies begin to dominate the ERU. Understory vegetation would likely increase in both distribution and diversity in the medium-open tree state (State D) coinciding with the increase in area occupied. However, the projected increase in the closed canopy states would essentially serve to offset that gain. The grass, forb, brush/shrub state would continue to decline as seedlings and saplings reestablish and encroach into these openings. In some cases, mechanical treatment may be required before the historic fire regime could be

reintroduced without compromising the residual vegetation. Conditions, particularly in seedlings and sampling, may improve by managing additional wildfires for resource objectives, but this option is not available within wildland-urban interface (1987 Plan, pages 155 and 165) under alternative A. Consequently, this ERU would remain moderately departed in the short term with a trend toward desired conditions. In the long term, the ERU remains moderately departed, but the trend moves away from desired conditions. Fire return interval is expected to remain moderately departed with a trend away from the desired conditions.

Under this alternative, vegetation departure is expected to remain moderate with a trend that initially moves toward desired conditions, but in the long term moves away. Fire return interval is expected to remain moderately departed with a trend away from the desired conditions.

Alternative B (modified)

This ERU occurs within eight proposed management areas (Lake Mary Watersheds, Painted Desert, Volcanic Woodlands, Pine Belt, San Francisco Peaks, Flagstaff Neighborwoods, Walnut Canyon, Anderson Mesa) under Alternative B (modified). Approximately 88 percent is within Anderson Mesa (50 percent) and Volcanic Woodlands (38 percent). Alternative B (modified) clearly distinguishes between different Pinyon Juniper types on the forest and provides desired conditions, objectives and guidance that are specific to the each type. Other than the management direction that applies to all terrestrial ERUs (FW-Eco-DC-1 to 4; FW-TerrERU-All-DC-1 to 5; FW-TerrERU-All-S-1 to 4; FW-TerrERU-All-G-1 to 4) and that which is specific to this ERU (FW-TerrERU-PJ-DC-1 to 16; FW-TerrERU-PJ-O-1, 2, 3; FW-TerrERU-PJ-G-1 to 5), there is additional direction for this ERU within the Volcanic Woodlands Management Area (Volcanic Woodlands Management Approaches). Within this management area, an emphasis is placed on coordination with the National Park Service to ensure compatibility in the management of overlapping resources.

Under this alternative, approximately 3,618 acres of this ERU (slightly over 1 percent) would fall within the recommended wilderness areas. If designated by Congress, the wilderness areas would be managed according to applicable laws, policy, and forest plan direction (SA-Wild-DC-1 to 11; SA-Wild-O-1, 2; SA-Wild-S-1 to 5; SA-Wild-G-1 to 11). This direction typically limits active vegetation management and may have negative consequences with respect to meeting the ERU's vegetation and fire desired conditions in localized areas and over the long term.

Departure and trend from reference condition:

Under alternative B (modified), the expected treatments would make some small gains with respect to reducing vegetation departure in the short term, and the ERU would become more resilient to uncharacteristic disturbances. However, under either the low or high treatment objective, the changes are insufficient to offset the negative effects of excess regeneration and closing canopies in the long term (table 35). Open canopy, medium trees move toward the desired conditions, as do States B, C, and D which together form an uneven-aged multi-state group. The remaining states either increase departure or make short term improvements but then begin to depart again in the long term. The ERU would eventually lose some of the short term gains achieved with respect to the desired condition for vegetation. Under the low treatment objective (and under alternative A) the losses are greater than under the high treatment objective. The difference is largely attributable to the higher mechanical treatment objective associated with this alternative.

Unlike under alternative A, which does not have specific treatment objectives, under alternative B (modified), there are two identified treatment objectives. These objectives are defined by treatment ranges that were based upon, on the low end, the average number of mechanically treated acres on the forest over the past decade and on the high end, the upper end of the historic treatment range within this ERU. The

upper end is possible because of additional resources leveraged through partnerships with non-profit organizations and state agencies.

- Mechanically treat between 1,000 and 10,000 acres of Pinyon Juniper with Grass during each 10-year period over the life of the plan.
- Use naturally ignited wildfires (i.e., lightning-caused fires that are managed for resource objectives) to treat at least 3,750 acres of Pinyon Juniper with Grass within the natural fire regime during each 10-year period over the life of the plan.

Regionally consistent desired conditions for this ERU emphasize trees occurring as individuals, but occasionally in smaller groups, and ranging from young to old. Scattered shrubs and a dense herbaceous understory including native grasses, forbs and annuals are present to support frequent surface fires. Specifically, approximately half of the trees in the Pinyon Juniper Grassland ERU should be medium-sized trees growing in open canopy conditions. This is due, in large part, to the slower growth rates of pinyon pines and juniper and because trees greater than 20 inches d.r.c., while a desired component, are still relatively rare across the landscape.

Table 35. VDDT modeled output for Pinyon Juniper with Grass ERU under alternatives B (modified), C, and D

State	Description[1]	Desired %	Current %	Low Objective		High Objective	
				Year 15 %	Year 50 %	Year 15 %	Year 50 %
A	Grass, Forb, Brush/Shrub	5	23.0	12.9	19.7	13.6	3.8
B	B – Seedling, Sapling, Open	25	16.0	9.1	3.5	9.1	4.1
C	C – Small Trees, Open		26.0	10.7	4.8	11.0	4.6
E	E – Very Large Trees, Open		17.0	11.0	4.5	10.7	4.2
	Sub-total (B,C,E):		59.0	30.8	12.8	30.8	12.9
D	D – Medium Trees, Open	50	2.0	12.7	19.7	13.8	24.7
F	F – Seedling, Sapling, Closed	10	13.0	29.0	24.5	27.3	23.0
G	G – Small Trees, Closed	10	3.0	14.7	39.4	14.7	35.8
	Level of Departure[2]:	0%	60%	42%	48%	41%	43%

[1] The combination of States B, C and E are uneven-aged. All other states are single-storied (even-aged).

[2] Departure Levels = High (>66%), Moderate (34-66%), and Low (0-33%).

State A is projected to move toward the desired condition after the first 15 years and then drop below after 50 years under both the low and high treatment objectives. This continued decline in the grass, forb, and brush/shrub state is attributed to tree growth and establishment exceeding the number of acres treated.

Under both low and high treatment objectives, seedlings/saplings, small trees, and very large trees with open canopies (States B, C, and E) are projected to approach the desired condition after 15 years and then drop below after 50 years. This decline is attributed to the amount of area moving from open to closed canopy conditions within these size classes. Growth declines as canopy cover and competition increase. Treatments at the projected level are still unable to maintain the desired open conditions.

Medium trees with open canopies (State D), where the largest proportion of the ERU is desired, is projected to make substantial movement toward the desired condition after 15 years though the progress is greatest under the high treatment objective. This trend would continue through year 50, but at a much slower rate. Some movement of small trees into this size class would continue to occur, but slow growth rates and increasing closed conditions, combined with few annual acres treated, diminish the positive trend.

Under both the low and high treatment objectives, closed canopy seedlings and saplings (State F) are projected to increase, moving from slightly above the desired condition, to more than double the area currently occupied after 15 years. This negative trend is attributed to trees moving in from State B as canopies close. The trend begins to reverse back toward the desired condition after 50 years as trees grow into the next size class. Closed canopy conditions contribute to slow growth rates of trees within this state, slowing movement into the next size class. Treatments do not occur at a level to reduce the area occupied by trees in this state by a substantial amount.

State G, which contains small trees with closed canopies, is projected to increase under both treatment objectives, reaching and then eventually exceeding the desired condition after 15 years. This is attributed to growth of seedlings and saplings into this size class as well as movement of small trees from open to closed canopy conditions. After 50 years, the trend accelerates and moves farther away. Canopy closure continues to increase, slowing tree growth and movement into the next size class. Understory vegetation would suffer as the amount of area with closed canopy increases, shading out those species. Under both treatment objectives, the number of acres treated is insufficient to maintain the current condition within this state or to reverse the projected trend of continued expansion.

Under alternative B (modified), the numbers of snags may decrease in the short term, but would increase over time.

Under the proposed plan, the landscape scale desired condition for Pinyon Juniper snags is to have 5 snags per acre that are at least 8 inches d.r.c. and have an average of one 18-inch d.r.c. snag per acre (FW-TerrERU-PJ-DC-2). Under both the low and high objective of this alternative, the number of snags would be similar to the number under alternative A. In the short term, the number of snags would meet or exceed the desired conditions for 8-inch d.r.c. snag and slightly below the desired condition for 18-inch snags (table 36). In the long term, desired conditions for all snag sizes would be met. Conditions may be further improved through project-level design criteria focused on creating or retaining large snags.

Table 36. Pinyon Juniper with Grass estimated average of snags per acre under alternatives B (modified), C, and D

	Low Objective			High Objective		
	8 to 12 inches d.r.c.	12 to 18 inches d.r.c.	18+ inches d.r.c.	8 to 12 inches d.r.c.	12 to 18 inches d.r.c.	18+ inches d.r.c.
Existing	5.0	3.8	1.8	5.0	3.8	1.8
15 years	3.2	1.3	0.7	3.1	1.3	0.8
50 years	4.9	2.1	1.0	4.6	2.1	1.1

Under this alternative, the Pinyon Juniper with Grass ERU would have approximately 3,618 acres included as part of the recommended Strawberry Crater Wilderness, which is a small fraction (1.4 percent) of the total ERU. While the proposed forest plan direction for managing wilderness areas makes mechanical treatments unlikely to occur, the cinder soil type within these locations and lack of understory vegetation make wildfires less likely. Taken in combination, the relatively small area and the

low likelihood of wildfire suggest that the recommended wilderness area would have little effect on vegetation or fire return interval departure.

Under both the low and high treatment objectives, departure relative to the desired conditions for vegetation would see some improvement during the first 15 years. However, the number of acres treated annually would be insufficient to offset the negative impacts of excess regeneration and canopy closure. In the long term (50 years), the initial gains would experience some loss as seedlings, saplings, and small trees with closed canopies begin to dominate the ERU. As the area occupied by the medium-open tree state (State D) increases, the distribution and diversity of understory vegetation would likely also increase. However, the projected increase in the closed canopy states would essentially serve to offset that gain. Under the high treatment objective, the grass, forb, brush/shrub state would continue to decline as seedlings and saplings reestablish and encroach into these openings whereas under the low treatment objective, the grass, forb, brush/shrub state slowly increases. In some cases, mechanical treatment may be required before the historic fire regime could be reintroduced without compromising the residual vegetation. Conditions, particularly in seedlings and sapling states, may improve by managing additional wildfires for resource objectives. Under alternative B (modified), the lack of restrictions with respect to managing wildfires for resource objectives in wildland-urban interface would help maintain improvements to vegetation departure when compared to alternative A.

Under this alternative, overall vegetation departure is expected to remain moderate under both low and high treatment objectives. Under both treatment objectives, the trend initially moves toward the desired conditions, but in the long term slowly moves away. The history of fire suppression and the lack of fire treatments in this frequent fire ERU ensures that, despite the proposed treatment objectives, the fire return interval would remain moderately departed with a trend away from the desired conditions.

Alternative C

This ERU occurs in eight different proposed management areas (Anderson Mesa, Flagstaff Neighborwoods, Jack's Canyon, Painted Desert, Pine Belt, San Francisco Peaks, Volcanic Woodlands, and Walnut Canyon) under alternative C. The majority (87 percent) occurs within Anderson Mesa (49 percent) and Volcanic Woodlands (38 percent).

This alternative does not differ from alternative B (modified) in terms of recommended wilderness areas because none of the recommended wilderness areas contain this ERU except Strawberry Crater.

Departure and trend from reference condition:

It is expected that the consequences would still be similar to those of alternative B (modified).

Alternative D

Alternative D differs from alternative B (modified) in that no new wilderness areas are proposed beyond those that are under the current plan.

Departure and trend from reference condition:

Alternative D was modeled in the same way as alternative B (modified). The primary difference is that some areas that are available for treatment under alternative D are not available under alternative B (modified). However, since both the area in question and the treatment objective represent such a small proportion of the overall ERU, the likelihood of the two overlapping would be small, and the effect on the outcome would be negligible.

Other ERUs

The other 10 terrestrial ecological response units were described previously in the Affected Environment section. More detailed information can be found in the Ecological Sustainability Report (USDA Forest Service 2009a) and Assessment of the Management Situation (USDA Forest Service 2010a). The 1987 Plan includes management direction arranged by management areas rather than by ERU. Because of this, there may be a wide range in direction for any given ERU, depending on how many different management areas it overlaps. A full description of MAs can be found in the 1987 Plan.

Most of the following ERUs have received little, if any mechanical or prescribed fire treatments over the life of the current plan. Fire has primarily been managed with a suppression objective of 100 to 1,000 acres. It is assumed that there would be little to no change over current management levels under alternative A for many of these vegetation types because they have received very little past management, and the majority do not have specific treatment objectives. However, under the action alternatives, desired conditions have been clearly established, and as such, any management activities would maintain or move the ERU toward those desired conditions.

Desert Communities

According to mid-scale data, it is currently 100 percent late seral herb and shrubs types. Current condition mainly consists of closed canopy late seral herbaceous vegetation and shrubs. Open canopy late seral shrubs are lacking from the landscape according to LANDFIRE. The extent and continuity of the Desert Communities ERU has decreased relative to reference conditions because of activities occurring on lands of other ownership. A shift in understory species composition toward non-native species is likely due to the proximity and rapid growth of the Verde Valley communities, a history of domestic grazing, and recreational uses. An increase in the frequency and severity of wildfires is a logical consequence of increased abundance and distribution of non-native annual grasses (USDA Forest Service 2009a).

Projected increases in the frequency and intensity of drought would cause major changes in vegetation cover. Higher temperatures and decreased soil moisture would likely reduce the stability of soil aggregates. Loss of vegetative cover and reduced soil aggregate stability, coupled with increases in precipitation intensity, would dramatically increase potential erosion rates. The greater temperatures and higher rates of evapotranspiration predicted to co-occur with drought portend increased mortality for the dominant woody vegetation, and open the door for establishment of non-native annual grasses adapted to “escape” drought conditions (Archer and Predict 2008).

Alternative A

This ERU is within 10 different management areas under the 1987 Plan, but 87 percent is included within MA 11 - Verde Valley. There are no specific desired conditions for this ERU in the current plan; however, there is some guidance related to fire management, range improvement, water resources, and the use of best management practices with regard to invasive species (See 1987 Plan, pages 69, 168 to 170). Prescribed fire and wildfires may be managed for resource objectives (1987 Plan, page 92), but there is no provision for using wildfires managed for resource objectives in the wildland-urban interface (page 170). The suppression objective is to minimize cost and provide for personnel safety, while keeping fires to 10 acres or less in areas mapped as the wildland-urban interface (1987 Plan, page 93). In areas outside the wildland-urban interface, the suppression objective is to hold fires to 1,000 acres or less (1987 Plan, pages 94, 170). The suppression objectives can vary, depending on conditions and resources at risk and fire is not a key ecological process. Beyond using prescribed fires and wildfires managed for resource objectives, and emphasizing watershed condition, range management, upland game bird habitat, and dispersed recreation (1987 Plan, page 166), the existing Forest Plan provides little to no description of desired conditions for this ERU.

Departure from reference condition and trend:

The vegetation condition of Desert Communities is currently highly departed and trending away relative to the desired conditions. This is not a fire-adapted ERU. Under alternative A, management is not expected to increase substantially over current levels, but the high departure should also make this ERU a higher consideration for management, depending on available resources. Sustained management at historic levels could lead to a continued increase in canopy cover from non-native annual grasses, altered composition from the same non-native species, and altered vegetative structure due to the loss of woody vegetation; process is also expected to alter as fires are expected to burn at a severity, frequency, or scale that is outside the historic range of variability (USDA Forest Service 2009a). Under alternative A, the fire return interval and vegetation are expected to remain highly departed, trending away from the proposed desired conditions.

Alternative B (modified)

This ERU is within three proposed management areas (Red Rock, House Mountain-Lowlands, and Verde Valley), but 97 percent is included within Verde Valley. The management direction for this ERU is located in the sections that apply to all ecosystems (FW-Eco-DC-1 to 4), terrestrial ERUs (FW-TerrERU-All-DC-1 to 5, FW-TerrERU-All-G-1, 3), invasive species direction (FW-Invas-DC-1, 2, FW-Invas-G-1, 2, 3), and those that are specific to this ERU (FW-TerrERU-DC-DC-1 to 4).

Departure from reference condition and trend:

The consequences to departure and trend under alternative B (modified) are expected to be generally the same as under alternative A. Management is not expected to increase substantially over current levels. There are desired conditions, guidelines, and the management approaches (FW-Invas-DC-1, 2; FW-Invas-G-1, 2, 3) under this alternative for invasive species (including non-native annual grasses) which are known to affect the departure of the fire return interval and vegetation of this ERU. Though there are no treatment objectives for this ERU, any action that occurs in this ERU would follow the new proposed plan direction and would either maintain or move the ERU toward the proposed desired conditions.

Alternative C

This ERU occurs in three different proposed management areas (House Mountain Lowlands, Red Rock, and Verde Valley under alternative C. The majority (97 percent) occurs within Verde Valley. Approximately 949 acres of this ERU are proposed for wilderness under this alternative, which amounts to about 1.5 percent of this ERU. These acres are distributed among five recommended wilderness areas: Black Mountain (588 acres), Cedar Bench (189 acres), Cimarron-Boulder (65 acres), Deadwood Draw (42 acres), and Hackberry (65 acres). Recommended wilderness would be managed to maintain or enhance primitive and undeveloped characteristics; to preserve native species and unique features; to reduce evidence of modern human control and manipulations; and motor vehicle uses should only occur for limited administrative and permitted activities to be consistent with wilderness character (FW- RWild-DC-1-3, G-3). If designated by Congress, the wilderness areas would be managed according to applicable laws, policy, and forest plan direction (SA-Wild-DC 1 to 11; SA-Wild-O-1, 2; SA-Wild-S 1 to 5; SA-Wild-G-1 to 11). This designation typically limits active vegetation management and may have negative consequences with respect to meeting the ERU's vegetation or watershed desired conditions over the 949 acres in the long term within the affected areas. There is no relevant direction associated with wilderness that is specific to Desert Communities.

Departure from reference condition and trend:

The consequences to departure and trend under alternative C are expected to be generally the same as under alternative B (modified). Though wilderness areas should be prioritized for the control of invasive

species (see Management Approaches for Invasive Species), managing such a small portion of this ERU as wilderness is not expected to alter the consequences.

Alternative D

Under this alternative, mechanized recreation is permitted in botanical areas and geological areas. However, recreation is limited to established tread on designated routes.

Departure from reference condition and trend:

The consequences to departure and trend under alternative D are expected to be generally the same as under alternative B (modified). Managing a portion of this ERU to allow restricted motorized recreation is not expected to alter the consequences.

Semi-desert Grassland

While grasslands on the Red Rock Ranger District are primarily in restorable native condition (65.5 percent), a large proportion (30.2 percent) of grasslands has become shrub-invaded, and have likely undergone a type conversion with little potential to be restored to open native grassland condition (USDA Forest Service 2009a). A restorable native condition is defined as a grassland with 10 to 35 percent total shrub cover and mesquite or juniper cover less than 15 percent whose herbaceous component is predominantly native perennial grasses and herbs (Schussman 2006). Shrub cover could be reduced with prescribed burns if sufficient fuels are present to carry a fire of adequate severity.

During drought, vegetation production is substantially curtailed and litter may increase as plants die, resulting in increased susceptibility to fire. Mesquite is very drought-tolerant and is known to invade grasslands. Wind erosion as a result of drought damage to the perennial grasses can be of concern. On sandy soils, large areas left bare by drought could begin to erode with the ever-present spring winds. Sand would drift until it reached fences, mesquite plants, buildings, or other obstacles. Many grass plants not killed by moisture stress could be killed by sand deposition (Herbel et al. 1972).

Open perennial grasslands and herbaceous understory are now present only in trace amounts. Lack of fire has contributed to, and would likely continue, a shift to shrub- and tree-dominated grasslands, which were largely absent in the historic landscape (USDA Forest Service 2009a).

Alternative A

This ERU is within 17 different management areas under the 1987 Plan, but 88 percent is included within MA 10 - Grassland and Sparse Pinyon Juniper Above the Rim, MA 11 – Verde Valley, and MA 27 - Savannah. The different types of grasslands were not distinguished in the current forest plan, so consequently, there are no specific desired conditions for this ERU in the current plan; however, there is some guidance related to fire management, water resources, wildlife habitat, and range improvement (see 1987 Plan, pages 162-165; 168-170; 206-50 to 206-51). Prescribed fire and wildfires may be managed for resource objectives, but there is no provision for using wildfires managed for resource objectives in the wildland-urban interface (1987 Plan, page 92). Prescribed fires outside the wildland-urban interface are intended to meet resource objectives, while also protecting life, property, private in-holdings, and other landownership (1987 Plan, page 94). The suppression objective is to minimize impact on the land while keeping fires to 10 acres or less in areas mapped as the wildland-urban interface (1987 Plan, page 93). In areas outside the wildland-urban interface, the suppression objective is to minimize cost and provide for personnel safety, while holding fires to 1,000 acres or less (1987 Plan, page 94). The suppression objectives can vary depending on conditions and resources at risk. In MA 27, specific guidance states that low-severity prescribed burns are desired unless life and property are threatened.

Departure and trend from reference condition:

The vegetation condition of Semi-desert Grasslands is currently highly departed and trending away relative to the desired vegetation conditions. Fire return interval is highly departed and trending away from desired conditions. Under alternative A, there is no specific treatment objective and management is not expected to increase substantially over current levels, but the high departure should make this ERU a higher consideration for management depending on available resources. Continued management at historic levels could lead to an irreversible shift toward shrubs and trees in about 30 percent of this ERU (USDA Forest Service 2009a), and a shift toward more severe fires, therefore this ERU will continue to trend away from desired conditions. No treatment objectives are provided.

Alternative B (modified)

This ERU occurs within four proposed management areas under alternative B (modified) (Red Rock, House Mountain-Lowlands, Sedona Neighborwoods, and Verde Valley), but 91 percent is included within Verde Valley (64 percent) and House Mountain Lowlands (27 percent). Alternative B (modified) clearly distinguishes between different grassland types on the forest and provides desired conditions, objectives, and guidance that are specific to the each type. Management direction would promote properly functioning ecosystems that are resilient to natural disturbances and climate change; promote characteristic disturbances and reduce the threat of uncharacteristic disturbances, and promote balance between desirable non-native species and subspecies and properly functioning ecosystems thereby furthering sustainability and adaptability (FW-Eco-DC-1-4, FW-TerrERU-All-DC-2).

Plan components for all terrestrial ERUs promote a mosaic of vegetation conditions, densities, and structures at different scales; ecosystems that are interconnected based on natural patterns; and restoration of desired disturbance regimes (FW-TerrERU-All-DC-1-5, G-1, 3). The maintenance of ecosystems and native species would be further supported by preventing, controlling, or eradicating invasive species and managing invasive species at levels that do not disrupt ecological composition, structure, and function; do not disrupt the natural fire regime; or do not affect the sustainability of native and desirable non-native species (FW-Invas-DC-1,2, G-1-3). ERU-specific direction would provide for a variety of native species with varying seral stages in natural patterns of abundance and distribution that support natural disturbances (FW-TerrERU-Grass-DC-1-5, 7, 8, 9; G-2).

An additional 132 acres (0.1 percent of the ERU) are in the Davey's recommended wilderness under this alternative. Recommended wilderness would be managed to maintain or enhance primitive and undeveloped characteristics; to preserve native species and unique features; to reduce evidence of modern human control and manipulations; and motor vehicle uses should only occur for limited administrative and permitted activities to be consistent with wilderness character (FW- RWild-DC-1-3, G-3). If designated by Congress, the wilderness areas would be managed according to applicable laws, policy, and forest plan direction (SA-Wild-DC 1-11; -O-1-2; -S 1-5; -G-1-11). This designation typically limits active vegetation management and may have negative consequences with respect to meeting the ERU's vegetation or watershed desired conditions over the 132 acres in the long term within the Davey's recommended wilderness. Under this alternative, wildfires may be managed for resource objectives in more areas of the landscape than in alternative A, allowing increased opportunities to reduce the risk of uncharacteristic fire and to restore fire-adapted ecosystems (FW-TerrERU-All-G-2, FW-WUI-DC-4).

Departure and trend from reference condition:

This ERU has a treatment objective to restore or improve at least 3,500 acres (approximately 4 percent) every 10-year period during the life of the plan (FW-TerrERU-Grass-O-1). Semi-desert Grasslands were modeled for removal of woody vegetation at a rate of 350 acres per year, applied to States B and C, with

State B being reset to herbaceous (table 37) (FW-TerrERU-Grass-O-1). No fire was applied because there are no specific fire treatment objectives.

Table 37. VDDT modeled output for Semi-desert Grassland ERU (under alternatives B (modified), C, and D

State	Description	Desired %	Current %	Year 15 %	Year 50 %
A	Recently burned, sparsely vegetated	24.0	0.0	0.0	0.0
B	B – Grasses and forbs	76.0	0.0	6.0	15.0
C	C – Shrubs, seedling, sapling, small & medium trees, Open	0.0	26.0	15.0	6.0
D	D – Shrubs, Closed Very large trees, Open	0.0	74.0	79.0	79.0
	Level of Departure[1]:	0%	100%	94%	85%

[1] Departure Levels = High (>66%), Moderate (34-66%), and Low (0-33%).

The model predicts a favorable trend in State B as woody vegetation is cleared, and grasses and forbs begin to occupy more area within these grasslands. State A remains at 0 percent over the next 50 years, though in reality the outcomes may be more favorable as opportunities for managing wildfires for resource objectives become available.

Semi-desert Grasslands are currently highly departed and trending away relative to the desired vegetation conditions. Fire return interval is highly departed and trending away from desired conditions. Under alternative B (modified), the proposed management is not expected to create a dramatic change over current levels, but the high departure is reduced and set toward a favorable trend. The small acreage falling within the recommended wilderness area would have no effect on departure. The slight increase in management over historic levels could be enough to impede a possible irreversible shift toward shrubs and trees in about 30 percent of this ERU. Under alternative B (modified), the vegetation condition of this ERU is expected to remain highly departed, but should begin trending slightly toward desired conditions. The fire return interval is expected to maintain a high departure and a trend away from the desired conditions due to the lack of plan objectives related to fire treatments.

Conditions may be further improved by managing additional wildfires for resource objectives (FW-TerrERU-All-G-2, FW-WUI-DC-4), an option that is not available within wildland-urban interface under alternative A.

Alternative C

This ERU occurs in four different proposed management areas (House Mountain Lowlands, Red Rock, Sedona Neighborwoods, and Verde Valley) under alternative C. The majority (64 percent) occurs within Verde Valley. This alternative differs from alternative B (modified) in that 12,041 acres are proposed for wilderness, which amounts to about 13.4 percent of this ERU. The acres are distributed among seven recommended wilderness areas with Hackberry having the most (4,327 acres), followed by Black Mountain (2,444), Cedar Bench (1,972), Cimarron-Boulder (1,907), Deadwood Draw (753), Walker Mountain (506), and Davey's (132). Recommended wilderness would be managed to maintain or enhance primitive and undeveloped characteristics; to preserve native species and unique features; to reduce evidence of modern human control and manipulations; and motor vehicle uses should only occur for limited administrative and permitted activities to be consistent with wilderness character (FW- RWild-DC-1-3, G-3). If designated by Congress, the wilderness areas would be managed according to applicable laws, policy, and forest plan direction (SA-Wild-DC 1-11; -O-1-2; -S 1-5; -G-1-11). This designation typically limits active vegetation management and may have negative consequences with respect to

meeting the ERU's vegetation or watershed desired conditions over the 12,041 acres in the long term within the seven recommended wilderness areas.

Departure and trend from reference condition:

Like alternative B (modified), there is an objective to restore/enhance 3,500 acres of Semi-desert Grassland during every 10-year period during the life of the plan.

Despite the removal of additional acreage proposed for wilderness from the areas that may be treated under this model, the outcome under this alternative is expected to be the same as under alternative B (modified). Given that about 4.1 percent of the ERU occurs in designated wilderness, the recommended wilderness footprint represents 13.4 percent of the total ERU and that the area proposed for treatment is also small, it is very unlikely that designated wilderness, recommended wilderness, and treatment areas would overlap.

Alternative D

Alternative D differs from alternative B (modified) in that no new wilderness areas are proposed beyond those that are under the current plan; otherwise, alternative D is the same as alternative B (modified).

Departure and trend from reference condition:

Alternative D was modeled in the same way as alternative B (modified). The primary difference is that some areas that are available for treatment under alternative D are recommended for wilderness under alternative B (modified). However, since the available areas and the treatment objective represent such a small proportion of the overall ERU, the likelihood of the two overlapping would be small, and the effect on the outcome would be negligible.

Great Basin Grassland

Some shrub and tree invasion is occurring along edges of grasslands. There is a shift from small to larger tree sizes, primarily in the northeastern part of the forest (about 17 percent of the ERU), near Wupatki National Monument. Stock tank construction has been attributed to shifts toward grazing-tolerant species; reduction in vegetation height; increases in soil compaction and disturbance; and shifts in abundance, density, and vigor of herbaceous species near water within this grassland type (USDA Forest Service 2009a). Vegetatively, this ERU is similar to reference conditions, although there is a shift in structure and composition to increased shrubs and trees in the northeastern part of the forest. This trend is likely to continue in the future due to lack of fire in the surrounding vegetation types, primarily pinyon juniper.

All of the grasslands on the Mogollon Rim and Flagstaff Ranger Districts (previously the Mogollon Rim, Mormon Lake, and Peaks Ranger Districts) were identified as being in restorable native condition, meaning that they have been encroached by shrubs and woody species, but have the potential to be restored to open native condition (Schussman 2006). Cover of woody vegetation could be reduced with prescribed burns if sufficient fuels are present to carry a fire of adequate severity. The restoration of grasslands on the Coconino to open native grassland condition, including the ecological functions that support them, would help promote the large-scale sustainability of important grassland areas within the Southwest (Schussman 2006).

Alternative A

This ERU is within 16 different management areas under the 1987 Plan, but 85 percent is included within MA 7 - Pinyon Juniper Woodland, Less Than 40 Percent Slope, MA 10 - Grassland and Sparse Pinyon Juniper Above the Rim, and MA 32 - Deadman Wash. The plan provides some very general guidance in terms of desired conditions, while providing direction to maintain and improve grasslands, including removing encroaching pinyon pines and juniper and re-introducing fire (pages 164; 206-87 to 206-88);

however, it remains silent on composition, structure, and function. Prescribed fire and wildfires may be used to meet resource objectives, but there is no provision for managing wildfires to meet resource objectives in the wildland-urban interface (1987 Plan, pages 92; 155; 164). Prescribed fires outside the wildland-urban interface are intended to meet resource objectives, while also protecting life, property, private in-holdings, and other landownership (1987 Plan, page 94). The suppression objective is to minimize impact on the land, while keeping fires to 10 acres or less in areas mapped as the wildland-urban interface (1987 Plan, page 93). In areas outside the wildland-urban interface, the suppression objective is to minimize cost and provide for personnel safety while holding fires to 1,000 acres or less (1987 Plan, page 94).

Departure and trend from reference condition:

This ERU is currently at low departure and is trending away with respect to desired conditions for vegetation. Fire return interval is highly departed and trending away from desired conditions. Based on historic management levels, the model assumes 700 acres of the ERU would be treated annually within this ERU. Under alternative A, management is not expected to change over current levels.

Trees and shrubs in states C and D are expected to continue encroaching with a corresponding decline in herbaceous species (table 38). This could impede fire's natural role within the ERU. Vegetation departure is expected to remain low over the first 15 years and then become moderately departed after 50 years. The fire return interval is expected to remain highly departed and trending away from desired conditions.

Table 38. VDDT modeled output for Great Basin Grassland ERU under alternative A

State	Description	Desired %	Current %	Year 15 %	Year 50 %
A	A - Recently burned, sparsely vegetated	5.0	0.0	0.3	0.3
B	B – Grasses and forbs	70.0	74.0	53.3	27.5
C	C – Shrubs, seedling, sapling, small & medium trees, Open	20.0	26.0	38.3	48.2
D	D – Shrubs, Closed Very large trees, Open	5.0	0.0	7.7	23.9
E	E – Noxious weeds/Invasives	0.0	0.0	0.1	0.1
	Level of Departure[1]:	0%	10%	21%	47%

[1] Departure Levels = High (>66%), Moderate (34-66%), and Low (0-33%).

Alternative B (modified)

This ERU occurs within eight proposed management areas (Painted Desert, Volcanic Woodlands, Pine Belt, Flagstaff Neighborwoods, Walnut Canyon, Anderson Mesa, Lake Mary, and Long Valley), but occurs primarily within Anderson Mesa (64 percent) and Painted Desert (24 percent). Alternative B (modified) clearly distinguishes between different grassland types on the forest and provides desired conditions, objectives, and guidance that are specific to the each type.

Management direction would promote properly functioning ecosystems that are resilient to natural disturbances and climate change; promote characteristic disturbances and reduce the threat of uncharacteristic disturbances; and promote balance between desirable non-native species and subspecies and properly functioning ecosystems, thereby, furthering sustainability and adaptability (FW-Eco-DC-1-4, FW-TerrERU-All-DC-2).

Plan components for all terrestrial ERUs promote a mosaic of vegetation conditions, densities, and structures at different scales; ecosystems that are interconnected based on natural patterns; and restoration

of desired disturbance regimes (FW-TerrERU-All-DC-1-5, G-1, 3). The maintenance of ecosystems and native species would be further supported by preventing, controlling, or eradicating invasive species and managing invasive species at levels that do not disrupt ecological composition, structure, and function; do not disrupt the natural fire regime; or do not affect the sustainability of native and desirable non-native species (FW-Invas-DC-1,2; G-1-3). ERU-specific direction would provide for a variety of native species with varying seral stages in natural patterns of abundance and distribution that support natural disturbances (FW-TerrERU-Grass-DC-1-4, 7, 8; FW-TerrERU-Grass-O-2; FW-TerrERU-Grass-G-1-2).

An additional 2,327 acres (2.5 percent of the ERU) are contained within the recommended Strawberry Crater wilderness under this alternative. Recommended wilderness would be managed to maintain or enhance primitive and undeveloped characteristics; to preserve native species and unique features; to reduce evidence of modern human control and manipulations; and motor vehicle uses should only occur for limited administrative and permitted activities to be consistent with wilderness character (FW- RWild-DC-1-3, G-3). If designated by Congress, the wilderness areas would be managed according to applicable laws, policy, and forest plan direction (SA-Wild-DC 1-11; -O-1-2; -S 1-5; -G-1-11). This designation typically limits active vegetation management and may have negative consequences with respect to meeting the ERU's vegetation or watershed desired conditions over the 2,327 acres in the long term within the Strawberry Crater recommended wilderness. Under this alternative, wildfires may be managed for resource objectives in more areas of the landscape than in alternative A, allowing increased opportunities to reduce the risk of uncharacteristic fire and to restore fire-adapted ecosystems (FW-TerrERU-All-G-2, FW-WUI-DC-4).

Prescribed fires and wildfires managed for resource objectives should not be used on areas with clayey soils until natural vegetative ground cover is near potential (FW-TerrERU-Grass- G-1); this would promote satisfactory and functional soils. There is also an objective to restore/enhance between 10,800 and 12,400 acres of this ERU every 10-year period during the life of the plan (FW-TerrERU-Grass-O-2).

Departure and trend from reference condition:

Historically, nearly three-fourths of the ERU was open mid-development grasses and forbs (State B), with about one-fifth of it in late development shrubs and trees with open canopy (State C).

Great Basin Grasslands were modeled for removal of woody vegetation from States C and D at a rate of between 10,800 (low treatment objective) and 12,400 (high treatment objective) acres every 10-year period during the life of the plan; these states were reset to herbaceous cover (State B). These objectives reflect best estimates of the levels of treatment required to maintain a low level of departure.

Under both the low and high treatment objectives, the model predicts that State B would initially trend away from the desired condition (table 39). At 50 years, the trend would generally remain static, but whereas under the low objective State B continues to decline, under the high objective there is a slight trend back toward the desired conditions. This is attributed to new seedlings from established encroaching trees and shrubs. The rate of establishment and growth of woody vegetation is greater than the rate at which those affected areas are being treated. Under both objectives, the area occupied by State C initially increases, but as the trees and shrubs continue to establish and grow, canopies would close and transition into State D. The proportion of State C declines as the proportion of State D increases and then surpasses the desired condition. By 50 years, this trend is predicted to accelerate to where 11 to 12 percent of the ERU is occupied by closed canopy shrubs and very large trees.

Table 39. VDDT modeled output for Great Basin Grassland ERU (low and high objectives) under alternatives B (modified), C, and D

State	Description	Desired %	Current %	Low Objective		High Objective	
				Year 15 %	Year 50 %	Year 15 %	Year 50 %
A	A - Recently burned, sparsely vegetated	5.0	0.0	2.1	2.4	2.3	2.5
B	B – Grasses and forbs	70.0	74.0	62.3	60.0	60.9	61.5
C	C – Shrubs, seedling, sapling, small & medium trees, Open	20.0	26.0	29.2	24.8	30.2	24.4
D	D – Shrubs, Closed Very large trees, Open	5.0	0.0	6.3	12.3	6.3	11.1
E	E – Noxious weeds/Invasives	0.0	0.0	0.1	0.5	0.2	0.6
	Level of Departure[1]:	0%	10%	11%	13%	12%	11%

[1] Departure Levels = High (>66%), Moderate (34-66%), and Low (0-33%).

Under alternative B (modified), under the low and high treatment objectives, this ERU is expected to maintain a low vegetative departure, while generally maintaining a static trend varying only slightly over years. There are no specific objectives for treatment using prescribed fire or wildfires managed for resource objectives, so the fire return interval is expected to remain highly departed with a trend away from the desired condition. The small area proposed for wilderness would have restrictions on mechanical treatment; however, in the relatively small proportion of the ERU (2.5 percent) that this area represents, the overall impacts to the ERU would be small and localized. Under this alternative, wildfires may be managed for resource objectives in more areas of the landscape than in alternative A, allowing increased opportunities to reduce the risk of uncharacteristic fire and to restore fire-adapted ecosystems (FW-TerrERU-All-G-2, FW-WUI-DC-4).

Alternative C

This ERU occurs in nine different proposed management areas (Anderson Mesa, Flagstaff Neighborwoods, Jack's Canyon, Long Valley, Painted Desert, Pine Belt, Pine Grove, Volcanic Woodlands, and Walnut Canyon) under alternative C. The majority (83 percent) occurs within Anderson Mesa (59 percent) and Painted Desert (24 percent). This alternative and alternative B (modified) propose the Strawberry Crater wilderness, the only recommended wilderness that contains Great Basin Grassland (about 2,327 acres). The effects are the same as for alternative B (modified).

Departure and trend from reference condition:

Alternative C was modeled in the same way as alternative B (modified), and the outcomes are expected to be largely the same.

Alternative D

Alternative D differs from alternative B (modified) in that no new wilderness areas are proposed beyond those that are under the current plan.

Departure and trend from reference condition:

Alternative D was modeled in the same way as alternative B (modified), and the outcomes are expected to be largely the same. The primary difference is that the 2,327 acres under alternative B (modified) that are proposed for wilderness are available for treatment under alternative D. However, since both the area in question and the treatment objective represent such a small proportion of the overall ERU, the likelihood of the two overlapping would be small, and the effect on the outcome would be negligible.

Montane/Subalpine Grassland

As in other grassland ERUs, there is a trend toward tree and shrub establishment within Montane/subalpine Grasslands especially along the periphery. Stock tank construction has also been attributed to shifts toward grazing-tolerant species; reduction in vegetation height; increases in soil compaction and disturbance; and shifts in abundance, density, and vigor of herbaceous species near water within this grassland type (USDA Forest Service 2009a). Composition, structure, and function are also at risk in localized areas as a result of presence of highly invasive species such as leafy spurge.

Alternative A

This ERU is currently within 18 different management areas under the 1987 Plan, the majority (54 percent) of which is included in MA 3 - Ponderosa Pine Mixed Conifer Less Than 40 Percent Slope and MA 9 – Mountain Grassland. Protection objectives within MA 3 include: suppression is 100 acres or less, prescribed fire and wildfire managed for resource objectives may be used to meet resource objectives, but wildfires may not as a management tool in the wildland-urban interface, and the annual average wildfire acreage burned should not exceed 750 acres per year on the average over a 10-year period (1987 Plan, pages 120, 137). These limitations to the role of fire in the ecosystem were designed to protect ponderosa pine suitable timberlands, but they also serve to inhibit the restoration of this ERU. The other management areas have similar direction except that MA 10 provides a 1,000-acre suppression objective outside of the wildland-urban interface (1987 Plan, page 165) and MA 35 provides guidance to reintroduce fire's natural role as much as possible (1987 Plan, page 206-98).

The current plan notes that dry and wet meadows interspersed throughout the mixed conifer (MA-3) are an important source of forage for wildlife and livestock, invading overstory vegetation should be eliminated where open meadows are to be maintained, and seeding of forage species is emphasized (1987 Plan, pages 117, 120, 160, 164). The plan promotes the maintenance of seral grasslands in MA-10 (1987 Plan, page 164). There are guidelines regarding relocation, obliteration, or closure of roads that are damaging or could damage meadows (1987 Plan, pages 206-70, 206-77, 206-78, 206-116,) More site-specific guidance in the Flagstaff-Lake Mary Ecosystem Area would protect, improve, and promote healthy functioning meadows in the Lake Mary and Oak Creek watersheds, and the Schultz, Walnut Canyon, West, and Doney Management Areas (MAs 36, 37, and 38) (1987 Plan, pages 206-78, 206-97,98,100; 206-103; 209-108; 206-114), and focuses road and trail maintenance in damaged meadows in the Doney Management Area (MA 33 – page 206-93). Although there is direction for mountain grasslands, and meadows, in numerous sections, the existing forest plan provides outdated forestwide direction on desired conditions for this ERU, especially in regard to plant composition, ecosystem function, and fire suppression.

Departure and trend from reference condition:

This ERU is currently at low departure (though nearly moderate) and is trending away with respect to desired conditions for vegetation. The fire return interval is moderately departed and trending away. There are no objectives under alternative A, and management within this ERU is not expected to change over current levels. This could continue to impede fire's natural role within the ERU. Vegetation departure is expected to become moderate as the continued lack of fire would allow trees and shrubs to further encroach, with a corresponding decline in herbaceous species. Invasive plants, such as leafy spurge, which were not historically present, add to the vegetation departure. Fire return interval is expected to remain moderate and trend away from the desired conditions.

Alternative B (modified)

This ERU occurs within 13 proposed management areas (Volcanic Woodlands, Pine Belt, San Francisco Peaks, Inner Basin, Flagstaff Neighborwoods, Mount Elden, Walnut Canyon, Anderson Mesa, Lake Mary Watershed, Red Rock, Long Valley, East Clear Creek, and C.C. Cragin). The majority (81 percent) of the

ERU occurs in the Pine Belt (47 percent), Long Valley (12 percent), Flagstaff Neighborwoods (11 percent), and San Francisco Peaks (11 percent). Alternative B (modified) clearly distinguishes between different grassland types on the forest and provides desired conditions, objectives, and guidance that are specific to each grassland type. Management direction would promote properly functioning ecosystems that are resilient to natural disturbances and climate change; promote characteristic disturbances and reduce the threat of uncharacteristic disturbances, and promote balance between desirable non-native species and subspecies and properly functioning ecosystems thereby furthering sustainability and adaptability (FW-Eco-DC-1-4, FW-TerrERU-All-DC-2). Plan components for all terrestrial ERUs promote a mosaic of vegetation conditions, densities, and structures at different scales; ecosystems that are interconnected, based on natural patterns; and restoration of desired disturbance regimes (FW-TerrERU-All-DC-1-5, G-1, 3). The maintenance of ecosystems and native species would be further supported by preventing, controlling, or eradicating invasive species and managing invasive species at levels that do not disrupt ecological composition, structure, and function; do not disrupt the natural fire regime; or do not affect the sustainability of native and desirable non-native species (FW-Invas-DC-1, 2, G-1-3). ERU-specific direction would provide for a variety of native species with varying seral stages in natural patterns of abundance and distribution that support natural disturbances (FW-TerrERU-Grass-DC-1-4, 6, 7, 8, 9; G-2). There is an objective to restore/enhance between 7,600 and 11,400 acres of this ERU every 10-year period during the life of the plan (FW-TerrERU-Grass-O-3).

There are no acres of this ERU in recommended wilderness under alternative B (modified).

Departure and trend from reference condition:

Montane/subalpine Grasslands were modeled for removal of woody vegetation from States C and D at a rate of between 7,600 and 11,400 acres of this ERU every 10-year period during the life of the plan; these states were reset to herbaceous cover (State B).

Under both the low and high treatment objectives, the model predicts that States B and C would trend toward the desired condition (table 40). State D would also trend toward the desired condition as treatments would be focused on removing closed canopy trees and shrubs. Vegetation departure is expected to remain low and trend toward the desired conditions.

Table 40. VDDT modeled output for Montane/Subalpine Grassland ERU under alternatives B (modified), C, and D

State	Description	Desired %	Current %	Low Objective		High Objective	
				Year 15 %	Year 50 %	Year 15 %	Year 50 %
A	A – Early development, open canopy (herbaceous)	20.0	0.0	17.0	16.4	18.9	15.7
B&C	B – Mid-development, open canopy (herbaceous)	80.0	68.0	69.1	80.0	70.9	80.0
D	D – Late development, closed canopy (trees, shrubs & herbaceous vegetation)	0.0	32.0	13.9	0.0	10.3	0.0
E	E – Noxious weeds/Invasives	0.0	0.0	0.0	0.0	0.0	0.0
	Level of Departure[1]:	0%	32%	14%	4%	10%	4%

[1] Departure Levels = High (>66%), Moderate (34-66%), and Low (0-33%).

There are no specific objectives for treatment using prescribed fire or wildfire managed for resource objectives, so the fire return interval is expected to remain moderately departed with a trend away from

the desired condition. Conditions may be further improved by managing wildfires to meet resource objectives (FW-TerrERU-All-G-2; FW-WUI-DC-4)), an option that was not available within wildland-urban interface under alternative A.

Alternative C

This ERU occurs in 13 different proposed management areas (Anderson Mesa, Blue Ridge, East Clear Creek, Flagstaff Neighborwoods, Hospital Ridge, Long Valley, Mount Elden, Pine Belt, Pine Grove, Red Rock, San Francisco Peaks, Volcanic Woodlands, and Walnut Canyon) under Alternative C. The majority (79 percent) occurs within Pine Belt (53 percent), Long Valley (14 percent), and Flagstaff Neighborwoods (12 percent). This alternative differs from alternative B (modified) in that 6 acres are also proposed for wilderness in the Railroad Draw recommended wilderness, which amounts to less than 0.1 percent of the ERU. There are no impacts to the ERU from wilderness recommendation due to this small extent.

Departure and trend from reference condition:

Alternative C was modeled in the same way as alternative B (modified). Despite the removal of the acreage proposed for wilderness from the areas that may be treated under this model, the outcome is expected to be the same as under alternative B (modified). Given that the recommended wilderness footprint represents only a small proportion of the total ERU and that the area proposed for treatment is also small, it is very unlikely that they would overlap.

Alternative D

Alternative D does not differ from alternative B (modified).

Departure and trend from reference condition:

The consequences of this alternative are expected to be the same as those of alternative B (modified).

Interior Chaparral

Interior Chaparral is adapted to high-severity fires in which over 75 percent overstory replacement is within the natural range of variability. Invasive and/or noxious weeds were not present under the reference condition, but they are currently present in limited numbers and are expected to increase.

Alternative A

This ERU is within 19 different management areas under the 1987 Plan, but 76 percent is included within wilderness. Portions of the ERU fall under Sedona/Oak Creek Ecosystem-wide plan direction (1987 Plan, pages 206-9 to 206-30) in addition to having more specific management area direction. The majority of the remaining area outside of wilderness (18 percent) falls under four other management areas (11, 14, 24, and 26). Management direction for Neighborwoods (MA 24) and Redrock frontcountry (MA 26) provide only scenery and recreation objectives. The remaining two (Verde Valley- MA 11 and Oak Creek Canyon-MA 14) represent only about 5,550 acres (11 percent of the total ERU) have plan direction related to active management. Sedona/Oak Creek ecosystem-wide plan direction includes provisions to conserve or restore natural ecosystem disturbance patterns and to promote the natural ecological role of fire within the constraints of human health and safety, while the mosaic of vegetative conditions reduce the occurrence of catastrophic fires (1987 Plan, page 206-9).

There are goals to expand the use of prescribed fire and other mechanical methods to achieve area goals and to utilize fire management to reduce fuels, restore ecosystem function and protect resource values (1987 Plan, page 206-11). Guidelines restrict prescribed burning so prevailing winds do not inundate active peregrine falcon nests during the breeding season and restrict fuel reduction activities that use motorized equipment at least one-quarter mile from active peregrine falcon nests to reduce activity and

noise-related impacts during the breeding season (1987 Plan, page 206-13). Scenery objectives would strive toward having management activities such as prescribed fire resulting in alterations that appear natural to most visitors (1987 Plan, page 206-15) and community objectives would reduce fire hazard and risk to protect community values and have the Fire Prevention Strategy updated to address fire risk and hazards in the wildland-urban interface (1987 Plan, page 206-19).

Ecosystem-wide direction would also prohibit camping and campfires in the Neighborwoods, Oak Creek Canyon, Redrock-Front-country, Gateway, Red Cliff, Dry Creek Basin, Special Area, and Transition MAs except in designated places (page 206-24). MA 11 and 14 provide the following additional objectives: Prescribed fire and wildfires managed for resource objectives may be used, but there is no provision for using wildfires managed for resource objectives in the wildland-urban interface (1987 Plan, page 92; page 170). Mechanical methods are also specifically cited as another means of achieving fire management goals (1987 Plan, page 184). Prescribed fires outside the wildland-urban interface are intended to meet resource objectives while also protecting life, property, private in-holdings, and other landownership (1987 Plan, page 94). The suppression objective is to minimize impact on the land, minimize cost and provide for personnel safety while keeping fires to 10 acres or less in areas mapped as the wildland-urban interface (1987 Plan, page 93; page 170). Within the Oak Creek Canyon, the suppression objective is 10 acres, but when fires are not a threat to people or improvements, the suppression objective may be increased to 300 acres (1987 Plan, page 94). In areas outside the wildland-urban interface, the suppression objective is to minimize cost and provide for personnel safety while holding fires to 1,000 acres or less (1987 Plan, page 94; page 170). The existing forest plan provides little to no direction on desired conditions for this ERU.

Departure and trend from reference condition:

The vegetation condition of interior chaparral is currently at a low level of departure with a static trend relative to the desired condition. The fire return interval is moderately departed and trending away from the desired condition. Under this alternative, there are no treatment objectives. Continued management at current levels over the long term could lead to decline in vegetative structure composition, and uncharacteristically large high-severity burned patches. Weed presence is also expected to expand and fire suppression objectives prevent fire from playing its natural role in the ERU.

Under this alternative, vegetation is expected to maintain a low level of departure with a trend away from desired conditions. After 50 years, the ERU is expected to become moderately departed. Fire return interval is expected to remain moderately departed and trending away from the desired conditions.

Alternative B (modified)

This ERU occurs within six different proposed management areas (Pine Belt, Red Rock, Oak Creek Canyon, House Mountain-Lowlands, Sedona Neighborwoods, and Verde Valley) under alternative B (modified), but 78 percent is falls within Sedona-Oak Creek MA. Alternative B (modified) clearly provides desired conditions and guidance. Management direction would, in general, promote properly functioning ecosystems that are resilient to natural disturbances and climate change; promote characteristic disturbances and reduce the threat of uncharacteristic disturbances, and promote balance between desirable non-native species and subspecies and properly functioning ecosystems, thereby furthering sustainability and adaptability (FW-Eco-DC-1-4, FW-TerrERU-All-DC-2).

Plan components for all terrestrial ERUs promote a mosaic of vegetation conditions, densities, and structures at different scales; ecosystems that are interconnected based on natural patterns; and restoration of desired disturbance regimes (FW-TerrERU-All-DC-1-5, G-1, 3). The maintenance of ecosystems and native species would be further supported by preventing, controlling, or eradicating invasive species and managing invasive species at levels that do not disrupt ecological composition, structure, and function; do

not disrupt the natural fire regime; or do not affect the sustainability of native and desirable non-native species (FW-Invas-DC-1, 2, G-1-3). ERU-specific direction would provide for a variety of native species with varying seral stages in natural patterns of abundance and distribution that support natural disturbances (FW-TerrERU-IC-DC-1-4; G-1). There is additional direction for this ERU within the wildland wildland-urban interface. Within wildland-urban interface, fire and vegetation management would favor low-severity surface fires, despite the historic fire regime that favors high-severity (and typically high-intensity) fires (FW-WUI-DC-8). This is intended to mitigate the risks to surrounding communities. Though there are no treatment objectives for this ERU, any action that occurs in this ERU would follow the new proposed plan direction and would either maintain or move the ERU toward the proposed desired conditions.

There are no acres of this ERU in wilderness recommended under alternative B (modified).

Departure and trend from reference condition:

Under this alternative, management is expected to generally continue at current levels. Vegetation condition departure is expected to remain low with a trend away from desired condition. However, the presence and increase of invasive species could reinforce the trend away from desired conditions. Fire return interval is expected to remain moderately departed and trending away from the desired conditions. Under this alternative, a potential shift in long-term trends away from the desired condition may be mitigated as wilderness (which represents 76 percent of this ERU) is prioritized for invasive species control (Management Approaches for Invasive Species). Conditions may also improve by managing wildfires for resource objectives when burning conditions permit (FW-TerrERU-All-G-2), an option that was not available within wildland-urban interface under alternative A.

Alternative C

This alternative differs from alternative B (modified) in that an additional 1,720 acres are proposed for wilderness (in Walker Mountain recommended wilderness), which amounts to about 3.4 percent of the total ERU (but approximately 15 percent of the ERU that is not already designated as wilderness).

Departure and trend from reference condition:

Alternative C was modeled in the same way as alternative B (modified). Despite the removal of additional acreage proposed for wilderness from the areas that may be treated under this model, the outcome is expected to be the same as under alternative B (modified). This is largely because there are no objectives for treatment.

Alternative D

This alternative does not differ from alternative B (modified) as it relates to interior chaparral.

Departure and trend from reference condition:

The consequences to this ERU under this alternative are the same as under alternative B (modified).

Pinyon-Juniper Evergreen Shrub

Pinyon Juniper Evergreen Shrub ERU is adapted to mixed-severity fire in which 25 to 75 percent of the dominant overstory is replaced. Historically, it was dominated by shrubs and medium to very large open grown trees. Invasive species were not historically present.

Alternative A

This ERU is within 23 different management areas under the 1987 Plan; however, it is primarily (61 percent) within MA 7 - Pinyon Juniper Woodlands less than 40 percent Slope, MA 11 – Verde Valley, and MA 10 – Grassland and Sparse Pinyon Juniper Above the Rim. An additional 18 percent is within

wilderness and 15 percent is in the Sedona/Oak Creek Ecosystem (10 individual management areas plus area-wide direction). The existing forest plan provides little direction on desired conditions for this ERU, as it is lumped into the broad vegetation category of Pinyon Juniper.

Management Area 10 is made up of grasslands and Pinyon Juniper with less than 10 percent cover above the Mogollon Rim, and emphasizes the use of prescribed fire to achieve management objectives associated with range, watershed condition, and wildlife habitat (1987 Plan, pages 162 to 165). Management Areas 7 and 11 provide direction to use mechanical treatment of vegetation, emphasizing management on a sustained-yield basis for firewood and miscellaneous convertible products (1987 Plan, pages 148 and 169). Additional direction is provided for MA 7 regarding the slope ranges where different management objectives should be focused. For example, old growth, cover, and snags are generally provided on slopes greater than 15 percent, while mechanical treatment should be managed on slopes less than 15 percent (1987 Plan, page 148).

Sedona/Oak Creek ecosystem-wide plan direction includes provisions to conserve or restore natural ecosystem disturbance patterns and to promote the natural ecological role of fire within the constraints of human health and safety, while the mosaic of vegetative conditions reduces the occurrence of catastrophic fires (1987 Plan, page 206-9). There are goals to expand the use of prescribed fire and other mechanical methods to achieve area goals and to utilize fire management to reduce fuels, restore ecosystem function, and protect resource values (1987 Plan, page 206-11).

Guidelines restrict prescribed burning so prevailing winds do not inundate active peregrine falcon nests during the breeding season and restrict fuel reduction activities that use motorized equipment at least one-quarter mile from active peregrine falcon nests to reduce activity and noise related impacts during the breeding season (1987 Plan, page 206-13). Scenery objectives would strive toward having management activities such as prescribed fire resulting in alternations that appear natural to most visitors (1987 Plan, page 206-15) and community objectives would reduce fire hazard and risk to protect community values and have the Fire Prevention Strategy updated to address fire risk and hazards in the wildland-urban interface (1987 Plan, page 206-19). Ecosystem-wide direction would also prohibit camping and campfires in the Neighborwoods, Oak Creek Canyon, Redrock-Front-country, Gateway, Red Cliff, Dry Creek Basin, Special Area, and Transition MAs (which contain this ERU) except in designated places (1987 Plan, page 206-24).

Prescribed fire and wildfires managed for resource objectives are permitted except within the wildland-urban interface (1987 Plan, pages 92, 155, 165, 170, 206-11). Prescribed fires outside the wildland-urban interface are intended to meet resource objectives, while also protecting life, property, private in-holdings, and other landownership (1987 Plan, page 94). The suppression objective is to minimize impact on the land, while keeping fires to 10 acres or less in areas mapped as the wildland-urban interface (1987 Plan, pages 155, 165, 170). In areas outside the wildland-urban interface, the suppression objective is to minimize cost and provide for personnel safety, while holding fires to 1,000 acres or less (1987 Plan, pages 55, 165, 170).

Departure and trend from reference condition:

The vegetation condition is currently moderately departed with a trend away from desired conditions. Fire return interval is highly departed and trending away from the desired conditions. There are no treatment objectives under alternative A, but it is projected that 3,750 acres would be treated over 10 years with wildfires managed for resource objectives. Attaining this projected treatment level would depend on the location of ignitions, conditions at the time of ignition, and resources at risk. This would likely reinforce the current trend of increasing tree density and cover. The increases would have a negative effect of shading understory species and maintaining a greater number of small to medium-sized trees than desired.

The structure, composition, and function of the ERU would be negatively affected by these changes and could also increase the vulnerability to insect and disease outbreaks. Furthermore, these same changes increase the potential for a greater proportion of the ERU to burn at the high end of the range for mixed-severity fires. This can result in greater soil loss and could facilitate the establishment and spread of invasive plant species, such as cheatgrass, which can alter the fire regime and the timing of fires.

Under alternative A, the vegetation condition of this ERU would remain moderately departed with a trend away from the desired condition. Fire return interval would remain highly departed and trend away from the desired conditions.

Alterative B (modified)

This ERU occurs within seven proposed management areas (Pine Belt, Red Rock, Oak Creek Canyon, House Mountain-Lowlands, Sedona Neighborwoods, Verde Valley, and Long Valley) under alternative B (modified). Approximately 77 percent is within Verde Valley (62 percent) and Red Rock (15 percent). Alternative B (modified) clearly distinguishes between different Pinyon Juniper types on the forest and provides desired conditions, objectives, and guidance that are specific to the each type. Management direction would promote properly functioning ecosystems that are resilient to natural disturbances and climate change; promote characteristic disturbances and reduce the threat of uncharacteristic disturbances, and promote balance between desirable non-native species and subspecies and properly functioning ecosystems, thereby, furthering sustainability and adaptability (FW-Eco-DC-1-4, FW-TerrERU-All-DC-2).

Plan components for all terrestrial ERUs would promote a mosaic of vegetation conditions, densities, and structures at different scales; ecosystems that are interconnected based on natural patterns; and restoration of desired disturbance regimes (FW-TerrERU-All-DC-1-5, G-1, 3). The maintenance of ecosystems and native species would be further supported by preventing, controlling, or eradicating invasive species and managing invasive species at levels that do not disrupt ecological composition, structure, and function; do not disrupt the natural fire regime; or do not affect the sustainability of native and desirable non-native species (FW-Invas-DC-1, 2, G-1-3).

ERU-specific direction would provide for a variety of native species with varying seral stages in natural patterns of abundance and distribution that support natural disturbances (FW-TerrERU-PJ-DC-5-9; G-1-3, 5). There is additional direction for this ERU within the wildland-urban interface. Within wildland-urban interface, fire and vegetation management would favor low-severity surface fires despite the historic fire regime that favors mixed-severity (and sometimes high-severity) fires (FW-WUI-DC-8). This is intended to mitigate the risks to surrounding communities.

Under this alternative, there is an objective to use naturally ignited wildfires (i.e., lightning-caused fires that are managed for resource objectives) to treat at least 3,750 acres in Pinyon Juniper Evergreen Shrub within the natural fire regime during each 10-year period over the life of the plan. Achieving this objective would depend on the location of ignitions, conditions at the time of ignition, and resources at risk.

Under this alternative, 723 acres of this ERU would fall within the Davey's recommended wilderness areas. Recommended wilderness would be managed to maintain or enhance primitive and undeveloped characteristics; to preserve native species and unique features; to reduce evidence of modern human control and manipulations; and motor vehicle uses should only occur for limited administrative and permitted activities to be consistent with wilderness character (FW-RWild-DC-1-3, G-3). If designated by Congress, the wilderness areas would be managed according to applicable laws, policy, and forest plan direction (SA-Wild-DC 1-11; -O-1-2; -S 1-5; -G-1-11). This designation typically limits active vegetation

management and may have negative consequences with respect to meeting the ERU's vegetation or watershed desired conditions over the 723 acres in the long term within this recommended wilderness.

Departure and trend from reference condition:

Across the ERU, tree density and canopy cover are likely to increase. The increases would have the negative effect of shading understory species and maintaining a greater number of small to medium-sized trees than desired. The structure, composition, and function of the ERU would be negatively affected by these changes and could also increase the vulnerability to insect and disease outbreaks. Furthermore, these same changes increase the potential for a greater proportion of the ERU to burn at the high end of the range for mixed-severity fires.

Under this alternative, Pinyon Juniper Evergreen Shrub would have slightly over 700 acres recommended as wilderness (Davey's), which is small fraction (less than 1 percent) of the total ERU. Across the ERU, including within wilderness, wildfires may be managed for resource objectives. The likelihood of using this management tool in wilderness depends on site-specific factors and environmental conditions at the time of ignition. Consequently, in areas where wildfires are managed for resource objectives, there would be a lower risk of uncharacteristic fire and fire severity, along with an increased likelihood of restoring the natural fire return interval. Where suppression is favored, the opposite effect would be expected.

Based on the treatment objective, the vegetation condition is expected to remain moderately departed with a trend away from the desired conditions. Fire return interval is expected to remain highly departed and trend away from the desired condition.

Alternative C

This ERU occurs in seven different proposed management areas (House Mountain Lowlands, Long Valley, Oak Creek Canyon, Pine Belt, Red Rock, Sedona Neighborwoods, and Verde Valley) under alternative C. The majority (62 percent) occurs within Verde Valley. This alternative differs from alternative B (modified) in that a substantial portion of the total ERU is recommended wilderness. About 50,164 acres are proposed, which represents approximately 19 percent of the total ERU. This would be distributed in the Black Mountain, Cedar Bench, Cimarron-Boulder, Davey's, Deadwood Draw, Hackberry, Railroad Draw, Tin Can, and Walker Mountain recommended wilderness areas. Recommended wilderness would be managed to maintain or enhance primitive and undeveloped characteristics; to preserve native species and unique features; to reduce evidence of modern human control and manipulations; and motor vehicle uses should only occur for limited administrative and permitted activities to be consistent with wilderness character (FW- RWild-DC-1-3, G-3). If designated by Congress, the wilderness areas would be managed according to applicable laws, policy, and forest plan direction (SA-Wild-DC 1-11; -O-1-2; -S 1-5; -G-1-11). This designation typically limits active vegetation management and may have negative consequences with respect to meeting the ERU's vegetation or watershed desired conditions over the 50,164 acres in the long term within these recommended wilderness areas.

Departure and trend from reference condition:

A substantial proportion (19 percent) of the ERU is within recommended wilderness areas. These areas are unlikely to receive mechanical treatment because it is inconsistent with the desired wilderness character (FW- RWild-DC-1-3, G-3). A substantial portion (18 percent) of this ERU is already within existing designated wilderness areas. When considered alongside the recommended wilderness areas, mechanical treatment would be restricted across 37 percent of the ERU.

While fire treatments are permitted within designated and recommended wilderness areas under this alternative, the likelihood of implementing fire treatments will depend on a number of site-specific factors

and conditions at the time. In some areas, mechanical pre-treatment may be required to attain the desired effects with a fire treatment; however, since motorized equipment is typically prohibited, some wilderness areas would likely be left untreated. As a consequence, wildfires in untreated areas are more likely to be suppressed and would have a greater risk of experiencing uncharacteristic wildfires with higher than desired fire severity and a decreased likelihood of attaining the desired condition. Nevertheless, since this ERU has a mixed-severity fire regime (where between 25 and 75 percent of the dominant overstory may be lost) and wildfires may be managed for resource objectives across the majority of the ERU, it is expected that the consequences would still be similar to those of alternative B (modified).

Based on the treatment objective, the vegetation condition is expected to remain moderately departed with a trend away from the desired conditions. Fire return interval is expected to remain highly departed and trend away from the desired condition.

Alternative D

Alternative D differs from alternative B (modified) in that no new wilderness areas are recommended beyond those that are under the current plan; otherwise it is similar.

Departure and trend from reference condition:

Alternative D was modeled in the same way as alternative B (modified). The primary difference is that some areas that are available for treatment under alternative D are not available under alternative B (modified) (namely recommended wilderness). However, since the areas in question represent such a small proportion of the overall ERU and the objective is to only treat with wildfires managed for resource objectives (which is permitted in wilderness), the difference in the effect between the two alternatives would be negligible.

Pinyon-Juniper Woodland

Pinyon-Juniper Woodland tends to have higher densities of tree and shrubs with higher canopy cover across extensive areas. As a result, understory vegetation such as grasses and forbs are sparse. Natural fires were historically infrequent and generally stand-replacing.

Alternative A

This ERU is within 24 different management areas under the 1987 Plan; however, it is primarily (66 percent) within MA 7 - Pinyon Juniper Woodlands less than 40 percent Slope, MA 8 – Pinyon Juniper Woodlands greater than 40 percent slope, and MA 11 – Verde Valley. Thirteen percent falls within the Sedona/Oak Creek Ecosystem (10 individual management areas plus area-wide direction). The existing forest plan provides little direction on desired conditions for this ERU, as it is lumped into the broad vegetation category of Pinyon Juniper. Management Area 8 emphasizes low management intensity, but provides for management using prescribed fires and wildfires managed for resource objectives except within the wildland-urban interface (1987 Plan, page 157). Management Areas 7 and 11 provide direction to use mechanical treatment of vegetation, emphasizing management on a sustained-yield basis for firewood and miscellaneous convertible products (1987 Plan, pages 148 and 169). Additional direction is provided for MA 7 regarding the slope ranges where different management objections should be focused. For example, old growth, cover, and snags are generally provided on slopes greater than 15 percent; while mechanical treatment should be managed on slopes less than 15 percent (1987 Plan, page 148).

Sedona/Oak Creek ecosystem-wide plan direction includes provisions to conserve or restore natural ecosystem disturbance patterns and to promote the natural ecological role of fire within the constraints of human health and safety, while the mosaic of vegetative conditions reduces the occurrence of catastrophic fires (1987 Plan, page 206-9). There are goals to expand the use of prescribed fire and other mechanical methods to achieve area goals and to utilize fire management to reduce fuels, restore ecosystem function

and protect resource values (1987 Plan, page 206-11). Guidelines restrict prescribed burning so prevailing winds do not inundate active peregrine falcon nests during the breeding season and restrict fuel reduction activities that use motorized equipment at least one-quarter mile from active peregrine falcon nests to reduce activity and noise-related impacts during the breeding season (1987 Plan, page 206-13). Scenery objectives would strive toward having management activities such as prescribed fire resulting in alternations that appear natural to most visitors (1987 Plan, page 206-15) and community objectives would reduce fire hazard and risk to protect community values and have the Fire Prevention Strategy updated to address fire risk and hazards in the wildland-urban interface (1987 Plan, page 206-19). Ecosystem-wide direction would also prohibit camping and campfires in the Neighborwoods, Oak Creek Canyon, Redrock-Front-country, Red Cliff, Dry Creek Basin, and Transition MAs (which contain this ERU) except in designated places (1987 Plan, page 206-24).

Prescribed fire and wildfires managed for resource objectives may be used, but there is no provision for using wildfires managed for resource objectives in the wildland-urban interface (1987 Plan, pages 92, 155, 157, 170, 206-11). Prescribed fires outside the wildland-urban interface are intended to meet resource objectives, while also protecting life, property, private in-holdings, and other landownership (1987 Plan, page 94). The suppression objective is to minimize impact on the land while keeping fires to 10 acres or less in areas mapped as the wildland-urban interface (1987 Plan, pages 155, 165, 170). In areas outside the wildland-urban interface, the suppression objective is to minimize cost and provide for personnel safety while holding fires to 250 acres or less in MA 8 and 1,000 acres or less in MAs 7 and 11 (1987 Plan, pages 94, 155, 157, 170).

Departure and trend from reference condition:

The vegetation condition currently has a low departure with a static trend relative to the desired conditions. Fire return interval departure is low but trending away from the desired conditions. There are no treatment objectives under alternative A, and continued management at current levels would likely maintain high tree density and cover over extensive areas. This condition is appropriate for the ERU and would support the historic fire regime of infrequent high-severity fires.

Under alternative A, the vegetation condition of this ERU is expected to maintain a low departure with a static trend relative to the desired condition. Fire return interval departure would remain low but trending away from the desired conditions, based on recent wildfire activity and the lack of treatment objectives.

Alternative B (modified)

This ERU occurs within 14 proposed management areas (Painted Desert, Volcanic Woodlands, Pine Belt, San Francisco Peaks, Flagstaff Neighborwoods, Walnut Canyon, Anderson Mesa, Red Rock, Oak Creek Canyon, House Mountain-Lowlands, Sedona Neighborwoods, Verde Valley, Long Valley, and East Clear Creek) under alternative B (modified). Approximately 87 percent is within Verde Valley (40 percent), Anderson Mesa (30 percent), and Volcanic Woodlands (17 percent). Alternative B (modified) clearly distinguishes between different Pinyon Juniper types on the forest and provides desired conditions, objectives and guidance that are specific to the each type. Management direction would promote properly functioning ecosystems that are resilient to natural disturbances and climate change; promote characteristic disturbances and reduce the threat of uncharacteristic disturbances, and promote balance between desirable non-native species and subspecies and properly functioning ecosystems thereby furthering sustainability and adaptability (FW-Eco-DC-1-4, FW-TerrERU-All-DC-2).

Plan components for all terrestrial ERUs promote a mosaic of vegetation conditions, densities, and structures at different scales; ecosystems that are interconnected based on natural patterns; and restoration of desired disturbance regimes (FW-TerrERU-All-DC-1-5, G-1, 3). The maintenance of ecosystems and native species would be further supported by preventing, controlling, or eradicating invasive species and

managing invasive species at levels that do not disrupt ecological composition, structure, and function; do not disrupt the natural fire regime; or do not affect the sustainability of native and desirable non-native species (FW-Invas-DC-1, 2, G-1-3). ERU-specific direction would provide for a variety of native species with varying seral stages in natural patterns of abundance and distribution that support natural disturbances (FW-TerrERU-PJ-DC-5-9; G-1-3, 5). There is additional direction for this ERU within the wildland-urban interface. Within wildland-urban interface, fire and vegetation management would favor low-severity surface fires, despite the historic fire regime that favors high-severity (and typically high-intensity) fires (FW-WUI-DC-8). This is intended to mitigate the risks to surrounding communities. There are no treatment objectives under this alternative.

Under this alternative, approximately 1,467 acres of this ERU would fall within the recommended wilderness areas (Strawberry Crater and Davey's). Recommended wilderness would be managed to maintain or enhance primitive and undeveloped characteristics; to preserve native species and unique features; to reduce evidence of modern human control and manipulations; and motor vehicle uses should only occur for limited administrative and permitted activities to be consistent with wilderness character (FW- RWild-DC-1-3, G-3). If designated by Congress, the wilderness areas would be managed according to applicable laws, policy, and forest plan direction (SA-Wild-DC 1-11; -O-1-2; -S 1-5; -G-1-11). This designation typically limits active vegetation management and may have negative consequences with respect to meeting the ERU's vegetation or watershed desired conditions over the 1,467 acres in the long term within these recommended wilderness areas.

Departure and trend from reference condition:

Under this alternative, management is not expected to increase over the current levels. This is expected to have the effect of maintaining high tree density and cover over extensive areas. The increases would have the effect of increasing the vulnerability to insect and disease outbreaks. It is also expected to shade out understory species at the landscape scale, though at fine scales, understory cover could be more abundant. This condition is appropriate for the overall ERU and would support the historic fire regime of infrequent high-severity fires.

Under this alternative, slightly over 1,400 acres are within recommended wilderness areas; this represents a small fraction (2 percent) of the total ERU. There are no treatment objectives for this ERU. While the proposed forest plan direction for managing wilderness areas makes mechanical treatments unlikely to occur, the cinder soil type within these locations and lack of understory vegetation make wildfires less likely to spread. Taken in combination, the relatively small area and the low likelihood of wildfire suggest that the recommended wilderness area would have little effect on vegetation or fire return interval departure.

Under this alternative, the vegetation condition of this ERU is expected to maintain a low departure with a static trend relative to the desired condition. Fire return interval departure would remain low but trending away from the desired conditions. Conditions may further improve by managing wildfires to meet resource objectives (FW-TerrERU-All-G-2), an option that is not available within wildland-urban interface under alternative A.

Alternative C

This ERU occurs in 15 different proposed management areas (Anderson Mesa, East Clear Creek, Flagstaff Neighborwoods, House Mountain Lowlands, Jack's Canyon, Long Valley, Oak Creek Canyon, Painted Desert, Pine Belt, Red Rock, San Francisco Peaks, Sedona Neighborwoods, Verde Valley, Volcanic Woodlands, and Walnut Canyon) under alternative C. The majority (68 percent) occurs within Verde Valley (40 percent) and Anderson Mesa (28 percent). This alternative differs from alternative B (modified) in that a substantial portion of the total ERU is proposed for conversion to wilderness. About

13,600 acres are proposed, which represents approximately one-fifth of the total ERU. These acres are distributed in the following recommended wilderness areas: Black Mountain, Cedar Bench, Cimarron-Boulder, Davey's, Deadwood Draw, East Clear Creek, Hackberry, Strawberry Crater, Tin Can, and Walker Mountain.

Departure and trend from reference condition:

Approximately 4,000 acres of the 13,600 acres proposed as wilderness would have a moderate to very high likelihood of being suppressed. This is largely due to a combination of management limitations including: limited accessibility and low likelihood of vegetative treatments in wilderness areas; the vegetative characteristics within the wilderness (e.g., continuous fuels, high departure, and closed canopy conditions); and threatened values immediately outside the wilderness area. These conditions are found within Black Mountain, Cedar Bench, Tin Can, Walker Mountain, and Deadwood Draw recommended wilderness areas.

Within the majority of the remaining recommended wilderness areas (East Clear Creek, Strawberry Crater, Davey's, Cimarron-Boulder, and Hackberry), wildfires could be managed to meet resource objectives and are less likely to be suppressed. Pre-treatment of the existing vegetation would likely be needed to minimize the negative effects of fire; however the restrictions placed on using motorized equipment within wilderness areas would make appropriate levels of vegetation pre-treatment impractical.

There would be increased risk of stand-replacing fire over a larger proportion of the ERU and a decreased likelihood of restoring the natural fire interval in localized areas where suppression is favored. Nevertheless, since naturally ignited fires may be managed across the vast majority of the ERU and the desired fire interval is rather long, it is expected that the consequences would still be similar to those of alternative B (modified).

Alternative D

Alternative D differs from alternative B (modified) in that no new wilderness areas are proposed beyond those that are under the current plan otherwise it is similar.

Departure and trend from reference condition:

Alternative D was modeled in the same way as alternative B (modified). The primary difference is that some areas (recommended wilderness) that are available for treatment under alternative D are not available under alternative B (modified). However, since the area in question represents such a small proportion of the overall ERU (2 percent) and there are no treatment objectives, the difference in the effect between the two alternatives would be negligible.

Mixed Conifer with Infrequent Fire

Alternative A

This ERU represents approximately 2 percent of the forest area and occurs within 13 different management areas under the 1987 Plan; however, it is primarily (85 percent) within MA 3 - Ponderosa pine and mixed conifer on less than 40 percent slope, MA 1 – Wilderness, MA 4 - Ponderosa pine and mixed conifer on greater than 40 percent slope, and MA 36 – Schultz. The existing Forest Plan provides little direction on specific desired conditions for this ERU; however, there is broad forestwide direction (1987 Plan, pages 70-1-2, 117-140) including specific direction relating to species habitat requirements (pages 65 to 65-11) (see Mexican spotted owl and norther goshawk discussion below).

There is direction to conform to the Mexican Spotted Owl Recovery Plan (1987 Plan, page 64). However, species recovery plans may be revised over the life of a forest plan. Currently, under alternative A,

language from an earlier version of the Recovery Plan is integrated into the 1987 Plan and is in conflict with the most current recovery plan recommendation, does not reflect current science, and could be in conflict with future recovery plan revisions. For example, the language that was integrated into the current forest plan refers to "protected habitat" and "restricted habitat" which are outdated terms that are no longer used (1987 Plan, page 65). Furthermore, the current recovery plan recognizes that stand-replacing wildfires are the greatest threat to Mexican spotted owl habitat and does not recommend diameter caps (USDI Fish and Wildlife Service 2012b). There is a 9-inch d.b.h. limitation on tree cutting in most protected activity centers and on steep slope protected habitat for fire risk abatement in the current forest plan (1987 Plan, page 65-2, 65-3). This diameter cap is not as effective as other approaches in reducing the risk of fire and is not considered to be a valid approach for promoting and sustaining Mexican spotted owl habitat. Harvest activities, are limited and only fire risk abatement treatments and some fuelwood harvests are permitted in protected habitat. As a consequence of this direction and the associated treatment limitations (1987 Plan, pages 65; 65-2 to 65-4), any treatments prescribed under the existing forest plan would likely be too conservative to either maintain the desired age and structural diversity or to abate fire risk.

Little vegetation management in Mixed Conifer with Infrequent Fire has occurred over the life of the current plan because forest treatments have focused on slopes less than 40 percent, the wildland-urban interface, ponderosa pine stands, and areas outside of both PACs and designated wilderness. Under the current plan direction, treatments have tended to leave higher stocking densities than appropriate to promote and maintain the desired diversity in structure and composition within this ERU. This is expected to continue to be the case.

Prescribed fire and wildfires managed for resource objectives may be used, but there is no provision for using wildfires managed for resource objectives in the wildland-urban interface (1987 Plan, pages 92, 111, 137). Annual average wildfire acreage burned should not exceed 750 acres per year on the average over a 10-year period in MAs 3 and 4 (1987 Plan, page 137). These limitations to the role of fire in the ecosystem were designed to protect ponderosa pine suitable timberlands, but they also serve to inhibit the restoration of this ERU. Prescribed fires outside the wildland-urban interface are intended to meet resource objectives while also protecting life, property, private in-holdings, and other landownership (1987 Plan, page 94). The suppression objective is to minimize impact on the land while keeping fires to 10 acres or less in areas mapped as the wildland-urban interface (1987 Plan, pages 93, 155, 165). In areas outside the wildland-urban interface, the suppression objective is to minimize cost and provide for personnel safety while holding fires to 100 acres or less (1987 Plan, pages 94, 137).

Additional direction for Mexican spotted owl and northern goshawk habitat provide specific limitations on the use of prescribed fire and wildfires managed for resource objectives (referred to as "natural prescribed fire") (1987 Plan, pages 65-2 to 65-4; 65-9). In several cases, the existing structure is too dense and layered to achieve desired fire effects without mechanical pre-treatment. Some mechanical treatments have been done on slopes less than 40 percent or in areas to specifically treat aspen in this ERU (e.g., Hart Prairie Fuels Reduction Project). Mechanical treatments have generally not been conducted because the ERU is within Mexican spotted owl PACs, wilderness, and slopes greater than 40 percent. In general, little prescribed fire has been conducted.

Departure and trend from reference condition:

The vegetation condition is currently moderately departed with a trend away from the desired conditions. Fire return interval is moderately departed and trending toward the desired conditions. Up until recently, the fire return interval departure and trend were greater; however, recent wildfires have affected approximately one-sixth of the ERU. Continued management at current levels would likely maintain the

tree densities and canopy cover at levels greater than the reference conditions and the proposed desired condition.

The primary threat to this ERU is the lack of characteristic fire disturbance. Canopy cover is denser and more continuous across all developmental stages. Tree density and relative species abundance are the primary characteristics that are departed with respect to vegetation. Late successional species like the shade-tolerant spruce and fir species are beginning to dominate while the early successional species that are more adapted to fire are underrepresented. Older tree are missing in some cases, while in others they are present, but their presence is masked by the overabundance of younger trees (USDA Forest Service 2008a). While the ERU is adapted to mixed-severity fires, the existing composition and structure puts it at greater risk of severe fires over an uncharacteristically large extent than would be the case under historic conditions.

Insects and diseases are a natural component of this ERU and create beneficial fine-scale variability as they kill small patches of trees. However, both the recent increasing trends in canopy cover and density, along with shifts in species composition amplify the risks of insects and disease related mortality. Because a variety of tree species comprise mixed-conifer forests, there is a corresponding variety of insects that can cause damage in this ERU. On the Coconino NF, the most substantial damage is cause by Douglas-fir beetle, western spruce budworm, and fir engraver (Lynch et al. 2007).

Douglas-fir mortality has increased throughout the Southwestern Region during the past 5 to 10 years. Recent activity by Douglas-fir beetle has been primarily driven by drought conditions. During the most recent drought period, there has been a strong pattern of Douglas-fir beetle attacks focused on large trees heavily infected with Douglas-fir dwarf mistletoe and possibly root disease. Though the acreage affected by this insect on the Coconino NF is small with respect to the extensive mortality in ponderosa pine and pinyon juniper, the effects can be considerable because of the insect's preference for the largest trees, which are often highly valued (Lynch et al. 2007).

Under alternative A, management of this ERU is not expected to change over current levels, leading to a continued loss in age class diversity, increased canopy cover, loss of early successional species, and a reduction in herbaceous understory. It is expected that the vegetation condition would remain moderately departed while trending away from the desired conditions. Over the next 50 years, it is expected that conditions would worsen and vegetation would become highly departed with a continued trend away from desired conditions. Fire return interval is expected to remain moderately departed and begin to trend away from the desired conditions due to a lack of fire treatment (prescribed and wildfires managed for resource objectives) objectives or anticipated fire treatments.

Alternative B (modified)

This ERU occurs within seven proposed management areas (Pine Belt, San Francisco Peaks, Inner Basin, Mount Elden, Anderson Mesa, Lake Mary Watersheds, and Long Valley) under alternative B (modified). The majority (88 percent) occurs within San Francisco Peaks (53 percent), Mount Elden (16 percent), and Pine Belt (19 percent). Alternative B (modified) clearly distinguishes between different Mixed Conifer types on the forest and provides desired conditions, objectives, and guidance that are specific to the each type. Management direction would promote properly functioning ecosystems that are resilient to natural disturbances and climate change; promote characteristic disturbances and reduce the threat of uncharacteristic disturbances, and promote balance between desirable non-native species and subspecies and properly functioning ecosystems, thereby, furthering sustainability and adaptability (FW-Eco-DC-1-4, FW-TerrERU-All-DC-2).

Plan components for all terrestrial ERUs promote a mosaic of vegetation conditions, densities, and structures at different scales; ecosystems that are interconnected based on natural patterns; and restoration

of desired disturbance regimes (FW-TerrERU-All-DC-1-5, G-1, 3). The maintenance of ecosystems and native species would be further supported by preventing, controlling, or eradicating invasive species and managing invasive species at levels that do not disrupt ecological composition, structure, and function; do not disrupt the natural fire regime; or do not affect the sustainability of native and desirable non-native species (FW-Invas-DC-1, 2, G-1-3). ERU-specific direction would provide for a variety of native species with varying age classes and understory vegetation in natural patterns of abundance and distribution that support natural disturbances within historic ranges of frequency and severity (FW-TerrERU-MC-DC-1, 2; FW-Terr-ERU-MCIF-DC 1-10). There is additional direction for this ERU within the wildland-urban interface. Within wildland-urban interface, fire and vegetation management would favor low-severity surface fires, despite the historic fire regime that favors high-severity (and typically high-intensity) fires (FW-WUI-DC-8). This is intended to mitigate the risks to surrounding communities. Additional recommendations with regard to structure and composition, where applicable, are provided by reference to the Mexican Spotted Owl Recovery Plan.

Under this alternative, approximately 347 additional acres of this ERU would fall within the Abineau recommended wilderness areas. Recommended wilderness would be managed to maintain or enhance primitive and undeveloped characteristics; to preserve native species and unique features; to reduce evidence of modern human control and manipulations; and motor vehicle uses should only occur for limited administrative and permitted activities to be consistent with wilderness character (FW- RWild-DC-1-3, G-3). If designated by Congress, the wilderness areas would be managed according to applicable laws, policy and Forest Plan direction (SA-Wild-DC 1-11; -O-1-2; -S 1-5; -G-1-11). This designation typically limits active vegetation management and may have negative consequences with respect to meeting the ERU's vegetation or watershed desired conditions over the 347 acres in the long term within these recommended wilderness areas.

Departure and trend from reference condition:

There are no treatment objectives under this alternative. Furthermore, the majority of this ERU is located in either wilderness (where mechanical treatments are prohibited)), on slopes over 40 percent (which are where mechanical equipment cannot readily operate). Mexican spotted owl PACs also represent a substantial portion of this ERU and may have an effect on the kinds of treatments that would be implemented (FW-WFP-G-1).

Given the lack of objectives, treatment is not expected to increase substantially over current levels. The departed condition related to underrepresented early successional species, excessive density, poor age class diversity, and deficit understory vegetation is expected to persist across much of the ERU. The addition of 347 acres of recommended wilderness is not expected to affect treatment approaches. However, under alternative B (modified) clear direction is provided with regard to desired conditions at multiple scales including structure, composition, tree density ranges, and the proper role of disturbance agents like fire and insects. This direction would ensure that any treatments within this ERU, including those within PACs, would maintain or move the area toward the desired conditions. It is expected that the vegetation condition would remain moderately departed; however, the trend would remain static with respect to the desired conditions. Fire return interval is expected to remain moderately departed and begin trending away from the desired conditions. Though no specific treatment objectives have been provided, conditions may also improve by managing wildfires for resource objectives (FW-TerrERU-All-G), an option that was not available within wildland-urban interface under alternative A.

Alternative C

This ERU occurs in five different proposed management areas (Anderson Mesa, Long Valley, Mount Elden, Pine Belt, and San Francisco Peaks) under alternative C. The majority (77 percent) occurs within

San Francisco Peaks (53 percent) and Pine Belt (24 percent). This alternative does not differ from alternative B (modified) in terms of recommended wilderness areas.

Departure and trend from reference condition:

It is expected that the consequences would still be similar to those of alternative B (modified).

Alternative D

Alternative D differs from alternative B (modified) in that no new wilderness areas are proposed beyond those that are under the current plan.

Departure and trend from reference condition:

Alternative D was modeled in the same way as alternative B (modified). The primary difference is that some areas that are available for treatment under alternative D are not available under alternative B (modified). However, since the area in question represents such a small proportion of the overall ERU and there are no treatment objectives, the difference in the effect between the two alternatives would be negligible.

Spruce-Fir

Since fire suppression and logging occur less on spruce–fir forests than other forest types, disturbance regimes observed today are probably a good reflection of what they were historically (Lynch et al. 2007). However, within the Coconino NF, this ERU is still at risk because it is primarily found in one location on the forest and under extreme circumstances, it could potentially be lost (USDA Forest Service 2009a).

Alternative A

The Spruce-Fir ERU occurs within nine management areas, but accounts for less than 1 percent of the forest. It is located primarily within MA 1 – Wilderness (74 percent) and MA 17 – Special Areas (7 percent), both of which discourage or prohibit active management. Virtually no timber or vegetation management has occurred in this ERU under the current forest plan other than Snowbowl Ski Area removing hazardous trees and expansion of ski runs in 2011.

The existing forest plan provides little to no direction on desired conditions for this ERU. Management Area 1 emphasizes preservation and minimizing signs of human presence. Almost one-third of the remaining area outside of wilderness, such as the San Francisco Peaks Research Natural Area (within MA 17), also prohibits activities such as harvest (1987 Plan, page 195).

Within wilderness, wildfires are allowed to play their natural role provided that they conform to a series of prescribed conditions (1987 Plan, page 112). If they exceed prescription, the suppression objective is 10 acres or less. No direction is provided with regard to prescribed fire. Wildfires within the research natural area (MA 17) are allowed to burn undisturbed and prescribed fires may be used to meet resource objectives unless they threaten the uniqueness of the area (1987 Plan, pages 112, 196). Suppression tactics should minimize damage to the character of the research natural area.

There is no specific direction with regard Mexican spotted owl habitat in the spruce fir ERU; however, there are portions of four Mexican spotted owl PACs (totaling 733 acres) that fall within this ERU. The direction for the management of Mexican spotted owl PACs would apply to these areas (1987 Plan, pages 65-1 to 65-2).

Departure and trend from reference condition:

The Spruce-Fir ERU is adapted to high-severity fires in which over 75 percent overstory replacement is within the natural range of variability. The vegetation condition is currently moderately departed with a

trend toward the desired conditions. The fire return interval is moderately departed, but the trend is static relative to the desired conditions. There are no treatment objectives under alternative A, and continued management at current levels would likely reinforce the current trends.

There was a shift in age class distribution within the Spruce-Fir ERU as a result of a series of large wildfires in the early 1900s. These fires removed a substantial portion of the mature forest and reinitiated the stands. There is currently a substantial surplus of young to mid-aged trees. Sources of more frequent disturbance (e.g., small fires, insects, disease, and windthrow) have been less common recently, resulting is a deficit of early seral stages such as herbaceous openings, seedlings and young aspen.

In 2007, spruce beetle affected an estimated 340 acres. Spruce beetle outbreaks are typically associated with warm temperatures during the growing season and disturbance events such as sudden increases in woody debris such as from windthrow and logging slash. Outbreaks of spruce beetle tend to occur infrequently because the beetle prefers areas dominated by dense stands of large-diameter spruce. When outbreaks do occur, their impacts can be impressive, often converting Spruce Fir forests to fir-dominated forests. An unknown number of acres are affected by true fir beetles. Although reference conditions are unknown, the current conditions are considered to be within the historic range of variability, because only a small number of acres are affected, and insects and disease are thought to be at endemic levels for the ERU (USDA Forest Service 2009a).

Under alternative A, management of Spruce-Fir is not expected to change over current levels. It is expected that the vegetation condition would remain moderately departed but trending toward the desired conditions. Specifically, the current departed condition related to underrepresented early successional species, excessive density, poor age class diversity, and deficit herbaceous vegetation is expected to persist; however, in the absence of large scale disturbance, the mid-aged would develop into mature trees and small scale disturbances would replenish the early seral community components. Fire return interval is expected to remain moderately departed, but maintain a static trend relative to the desired conditions.

While the vegetation is departed from reference conditions, it is within the historic range of variability because this ERU experiences infrequent high-severity fires; there have been few large high-severity fires in this ERU since the 1900s, but since the historic fire return interval is over 200 years, it is within the expected range (USDA Forest Service 2009a).

Alternative B (modified)

The Spruce-Fir ERU accounts for less than 1 percent of the forest and is located within two proposed management areas (San Francisco Peaks and Pine Belt). The vast majority is within the San Francisco Peaks (98 percent). Management direction would promote properly functioning ecosystems that are resilient to natural disturbances and climate change; promote characteristic disturbances and reduce the threat of uncharacteristic disturbances, and promote balance between desirable non-native species and subspecies and properly functioning ecosystems, thereby, furthering sustainability and adaptability (FW-Eco-DC-1-4, FW-TerrERU-All-DC-2).

Plan components for all terrestrial ERUs promote a mosaic of vegetation conditions, densities, and structures at different scales; ecosystems that are interconnected based on natural patterns; and restoration of desired disturbance regimes (FW-TerrERU-All-DC-1-5, G-1, 3). The maintenance of ecosystems and native species would be further supported by preventing, controlling, or eradicating invasive species and managing invasive species at levels that do not disrupt ecological composition, structure, and function; do not disrupt the natural fire regime; or do not affect the sustainability of native and desirable non-native species (FW-Invas-DC-1, 2, G-1-3).

ERU-specific direction would provide for a functioning resilient ecosystem with all its components, processes, and conditions with a variety of native species of varying age classes and understory vegetation in natural patterns of abundance and distribution that support natural disturbances within historic ranges of frequency and severity (FW-TerrERU-SF-DC-1-11). There is additional direction for this ERU within the wildland-urban interface. Within wildland-urban interface, fire and vegetation management would favor low-severity surface fires despite the historic fire regime that favors high-severity (and typically high-intensity) fires (FW-WUI-DC-8). This is intended to mitigate the risks to surrounding communities.

Designated wilderness would be managed according to applicable laws, policy, and forest plan direction (SA-Wild-DC 1-11; -O-1-2; -S 1-5; -G-1-7, 9). Recommended wilderness areas do not include this ERU. Under this alternative, the current Mexican Spotted Owl Recovery Plan recommendations would be used to ensure that suitable habitat conditions are provided where Mexican spotted owl PACs overlap with this ERU.

Departure and trend from reference condition:

There are no treatment objectives under this alternative. Furthermore, the vast majority of this ERU is located within wilderness. As such, treatment is not expected to increase substantially over current levels. The departed condition related to underrepresented early successional species, excessive density, poor age class diversity, and deficit understory vegetation is expected to persist; however, in the absence of large-scale disturbance, the mid-aged would develop into mature trees and small scale disturbances would replenish the early seral community components.

Under alternative B (modified) clear direction is provided with regard to desired conditions at multiple scales including structure, composition, tree density ranges, and the proper role of disturbance agents like fire and insects. This direction would ensure that any treatments within this ERU would maintain or move the area toward the desired conditions. It is expected that the vegetation condition would remain moderately departed, but trending toward the desired conditions. Fire return interval is expected to remain moderately departed, but maintain a static trend relative to the desired conditions. Though no specific treatment objectives have been provided, conditions may also improve by managing wildfires for resource objectives (FW-TerrERU-All-G), an option that was not available within wildland-urban interface under alternative A.

Alternative C

This ERU occurs in two different proposed management areas (San Francisco Peaks and Pine Belt) under alternative C. The majority (98 percent) occurs within San Francisco Peaks. Recommended wilderness areas do not include this ERU.

Departure and trend from reference condition:

It is expected that the consequences would be similar to those of alternative B (modified).

Alternative D

This alternative does not differ from alternative B (modified) in terms of recommended wilderness areas.

Departure and trend from reference condition:

It is expected that the consequences would still be similar to those of alternative B (modified).

Alpine Tundra

Alpine Tundra is of particular concern because it is found in only one location on the forest and in the Southwestern Region of the Forest Service. In the worst case scenario, it could potentially be lost from the forest and region (USDA Forest Service 2009a).

Alternative A

This ERU is currently within four different management areas under the 1987 Plan; approximately 96 percent is within MA-16 Inner Basin, MA-17 Special Areas, and MA-1 Wilderness. Other than protection (1987 Plan, pages 65, 110) and guidance provided by the San Francisco Peaks Alpine Tundra Management Plan (page 65), there is little to no management direction for this vegetation type.

Departure and trend from reference condition:

The vegetation departure is currently low, but trending away from the desired conditions. This is not a fire-adapted system, so there are no desired conditions with regard to fire. There are no treatment objectives under alternative A, and continued management at current levels would likely reinforce the current trends. The trend away from desired conditions can be largely attributed to climate change, over which the forest has no control. Due to changes in weather patterns, there has been an increase in meadow species and a decrease in talus slope species. If localized warmer, drier conditions persist over time, this high-elevation-dependent ERU could experience pronounced shifts in composition and structure due to plant mortality, stress, or meadow species invasion. Recreation may also pose a threat, as off-trail recreation can damage plants. Departure is assumed to be within the historic range of variability, but changes in weather patterns could cause the departure to increase.

Under this alternative, it is unclear how departure would be affected. If current climate trends persist, the ERU may become moderately departed with respect to vegetation and this trend would continue to move away from the desired condition.

Alternative B (modified)

All of this ERU occurs within the San Francisco Peaks Management Area, most of which is in Kachina Peaks Wilderness. Management direction would promote properly functioning ecosystems that are resilient to natural disturbances and climate change; promote characteristic disturbances and reduce the threat of uncharacteristic disturbances; and promote balance between desirable non-native species and subspecies and properly functioning ecosystems, thereby, furthering sustainability and adaptability (FW-Eco-DC-1-4, FW-TerrERU-All-DC-2).

Plan components for all terrestrial ERUs promote a mosaic of vegetation conditions, densities, and structures at different scales; ecosystems that are interconnected based on natural patterns; and restoration of desired disturbance regimes (FW-TerrERU-All-DC-1-5, G-1, 3). The maintenance of ecosystems and native species would be further supported by preventing, controlling, or eradicating invasive species and managing invasive species at levels that do not disrupt ecological composition, structure, and function; do not disrupt the natural fire regime; or do not affect the sustainability of native and desirable non-native species (FW-Invas-DC-1, 2, G-1-3).

ERU-specific direction would provide for a functioning resilient ecosystem with all its components, processes, and conditions that support high-elevation ecological communities and sustain rare or narrowly endemic species (FW-TerrERU-AT-DC-1-2). Recreation would be managed to maintain, protect, or improve ecological attributes, processes, and habitat for native species (FW-TerrERU-AT-G-1; SA-Wild-S-1- 5).

Departure and trend from reference condition:

There are no treatment objectives under alternative B (modified), and continued management at current levels would likely reinforce the current trends. As the primary factor affecting this ERU is out of the forest's control, there is little difference between the alternatives. However, alternative B (modified) provides guidance with regard to protection from recreation (FW-TerrERU-AT-G-1), which may mitigate some negative impacts.

Under this alternative, it is unclear how departure would be affected. If current climate trends persist, the ERU may become moderately departed with respect to vegetation, and this trend would continue away from the desired condition.

Alternative C

Alternative C does not differ from alternative B (modified).

Departure and trend from reference condition:

It is expected that the consequences would still be similar to those of alternative B (modified).

Alternative D

Alternative D does not differ from alternative B (modified).

Departure and trend from reference condition:

It is expected that the consequences would still be similar to those of alternative B (modified).

Sub-ERU Tree Features

Aspen

Aspen occurs as individuals and groups that shift in location over time throughout the landscape. It establishes in response to canopy gaps created by disturbances. Over time, individuals and groups will decline and will be replaced by the surrounding conifers, but will then reestablish in new areas as subsequent disturbances create the appropriate early successional conditions. Aspen in the Southwest have been declining for decades. This decline is primarily attributable to altered fire regimes which have decreased the incidence of scattered canopy openings. Insect defoliators, drought and the inability of aspen regeneration to survive heavy browsing by ungulates has also encouraged the conversion of existing aspen patches to coniferous forest (USDA Forest Service 2009a).

Aspen mortality has been greatest at lower elevation. During the past 5 to 10 years, more than half of aspen sites below 7,500 feet elevation have experienced high rates of mortality. Continued hotter and drier conditions resulting from climate change are expected to exacerbate this decline as stressed trees become more susceptible to damaging agents and mortality. Aspen at higher elevations would become increasingly susceptible and higher rates of mortality should be expected. As overstory aspen weaken and die and competition from conifers increase, successful sprouting (suckering) is expected to decline.

Combined with the lack of fire disturbances, which provide opportunities for the establishment of aspen regeneration across the landscape, heavy browse pressure from ungulates, drought, frost, and insect defoliation can prevent aspen existing regeneration from reaching maturity, except within fenced areas. Extensive mortality of the established aspen component combined with a lack of fire disturbance and almost complete regeneration failure at lower elevations (lower than 8,500 feet), indicates that future persistence of aspen on the Coconino NF is not assured, except in relict locations at lower elevations (Lynch et al. 2007; Fairweather et al. 2007).

For the Coconino NF, aspen most often occurs in small localized areas and across several ERUs. This sub-ERU most commonly represents an early seral stage of the Mixed Conifer with Infrequent Fire and Spruce Fir ERUs; however, it can also occur in moister areas within the Mixed Conifer Frequent Fire and Ponderosa Pine ERUs. It was not included in the vegetation models because aspen occurs at too small of a scale to be appropriately modeled (USDA Forest Service 2009a). Based on substantial declines in mature and successfully regenerating aspen, the threat of warming climates, and fire suppression, the vegetation condition of aspen is believed to be highly departed with a trend away from desired conditions.

Furthermore, the current overall extent and presence of aspen across the landscape, is believed to be far less than reference conditions. The fire return interval departure is moderate and trending toward desired conditions based on its relatively infrequent historic fire return interval, the current fire return interval of associated ERUs, and its recent history of wildfire acreage burned.

Alternative A

The 1987 Plan emphasizes a combination of wildlife habitat, visual quality, firewood production, watershed condition, and dispersed recreation with other resources and uses managed to be compatible for MA 5 (Aspen). Guidelines include establishing and maintaining stand diversity through integrated stand management to provide suitable habitat for wildlife, while maintaining or enhancing firewood production, age class distribution, and sustained-yield of firewood using even-aged or uneven-aged silvicultural systems, depending on the objectives and existing condition of the stand. The 1987 Plan would protect regenerated areas and assign no grazing capacity until seedlings are established; protect areas or a group of areas by excluding grazing through fencing or other means where appropriate; and recommend no treatment of aspen if funding is not available for needed protection (1987 Plan, page 143). Fuel treatments would be implemented to favor aspen regeneration and have the least impact on the site. Prescribed fires and wildfires managed for resource objectives (except in the wildland-urban interface) are appropriate management tools and the suppression objective is to hold wildfires to 100 acres or less (1987 Plan, page 144).

Plan language under alternative A should promote the sustainability and maintenance of aspen where treatments focus on aspen regeneration that is protected from browsing. However, the vegetative condition of aspen is expected to remain highly departed with a trend away from desired conditions because not all areas are protected; maintenance of existing protective fencing is variable depending on funding or volunteer effort; and some aspen stands have been subject to drought, insect defoliators, browsing, and altered fire regimes that have exceeded the capacity of the root reserves to maintain stand vigor.

Aspen is adapted to disturbances like fire or windthrow and represents an early successional stage of other ERUs. Consequently, the fire return interval is largely dependent on the ERU in which it occurs. Where aspen occurs in Mixed Conifer with Infrequent Fire, the fire return interval is expected to remain moderately departed, but begin to trend away from the desired conditions due to a lack of fire treatment objectives or anticipated fire treatments. In Spruce-Fir, the fire return interval would be highly departed with a static trend. In both Mixed Conifer with Frequent Fire and Ponderosa Pine ERUs, the fire return interval would be highly departed with a slow trend toward desired conditions.

Alternative B (modified)

Plan components under these alternatives would promote the sustainability of aspen; would support vigorous and regenerating clones that shift in space and time; and maintain aspen through natural and mechanical disturbances that is protected when necessary (FW-TerrERU-AspMpl-DC-1-3, G-1).

The following objective is listed for aspen and maple:

Restore at least 1,000 acres of aspen and maple during each 10-year period over the life of the plan. Restoration could include, but is not limited to, activities that promote regeneration, remove competing vegetation, or remove disturbances that could negatively impact aspen or maple (FW-TerrERU-AspMpl-O-1)

Under alternative B (modified) active management of aspen is not expected to increase substantially over alternative A, and therefore, the consequences are expected to be similar. Pressure from ongoing herbivory, drought, and climate change make the outlook unclear for this landscape component. As a

species that is adapted to fire and, as a component of multiple frequent fire ERUs, the trend away from the desired vegetation conditions could be slowed as a result of the explicit restoration objectives in Ponderosa Pine and Mixed Conifer Frequent Fire that would create new canopy gaps across the full landscape and provide more opportunities to establish vigorous regeneration.

Alternative C
Alternative C does not differ from alternative B (modified).

Alternative D
Alternative D does not differ from alternative B (modified).

Maple
On the Coconino NF, bigtooth maple is a particularly valuable resource in terms of scenery, biodiversity, and habitat. It is shade-tolerant and occurs primarily in cool, moist drainage bottoms. It provides valuable habitat for a variety of species, though smaller maples tend to only be lightly browsed. Bigtooth maple is also relatively tolerant of fire, resprouting after low to moderate intensity fires. Recent prolonged drought conditions have had a negative effect on maple stands, though the species is not in severe decline.

Alternative A
Bigtooth maple occurs most prominently in the Mogollon Rim Botanical area on the Coconino NF (Special Areas - MA 17). The management direction emphasizes maintaining the existing conditions and natural processes for public enjoyment, demonstration, and study (1987 Plan, page 194). Timber harvest and firewood cutting is prohibited within this area (1987 Plan, page 195). In other areas where bigtooth maple occasionally occurs (Ponderosa Pine and Mixed Conifer less than 40 percent slope – MA3 and Mogollon Rim – MA19) the current plan provides a silvicultural prescription for bigtooth maple that emphasizes maintaining coniferous overstory that provides shading for existing and the regenerated maple areas, higher densities of large conifers (at least 120 BA in 10- to 16-inch d.b.h. trees), and well represented snags (280 snags per 100 acres) that are greater than 12 inches d.b.h. and greater than 15 feet high. White fir over 20 inches d.b.h. is not cut, nor is any white fir showing signs of rot (1987 Plan, page 132).

Very little management has historically occurred in maple stands; under this alternative there are no treatment or restoration objectives, so management is not expected to change over current levels. Prescribed fires with planned ignitions may be used as a management tool as long as it is compatible with management of the area (1987 Plan, page 196). Fires typically have low-severity effects in this sub-ERU since conditions tend to be moist and there is low fuels accumulation. During prolonged drought periods, the likelihood of higher severity fires increases; overstory trees may be lost, but may also resprout vigorously. Plan language should maintain bigtooth maple across the landscape where it naturally occurs.

Alternative B (modified)
Under alternative B (modified), maple is recognized as a component of Mixed Conifer with Infrequent Fire and Riparian Forest types. There is direction to provide for all age classes of maple and to ensure that it is regenerating vigorously (FW-TerrERU-AspMpl-DC-1). There is also an objective to restore 1,000 acres of aspen and maple over the next 10 years (FW-TerrERU-AspMpl-O-1).

Unlike under alternative A, there are restoration objectives for maple and aspen. The desired conditions provided under this alternative ensure that any action taken would maintain or improve the condition of this sub-ERU. It is expected that under this alternative, the condition of maple would be similar to or better than those under alternative A.

Alternative C
Alternative C does not differ from alternative B (modified).

Alternative D

Alternative D does not differ from alternative B (modified).

Gambel Oak

Alternative A

Under alternative A, Gambel oak is discussed as a component of ponderosa pine. It occurs within seven different management areas under the 1987 Forest Plan; however, MA3 – Ponderosa pine and mixed conifer on less than 40 percent slope provides the majority of the direction. Where it occurs with ponderosa pine or mixed conifer, there is direction to consider oak management in all activities (including harvest of other species) and to manage oak to improve wildlife habitat and provide firewood (1987 Plan, page 131). Specific silvicultural prescriptions are dictated that emphasize placing Gambel oak on a harvest rotation using a traditional shelterwood or an irregular shelterwood (1987 Plan, pages 131 to 132).

Within Mexican spotted owl protected activity centers, fuelwood should be harvested in a manner that minimizes effects to Mexican spotted owl including retaining oak (1987 Plan, page 65-2). On steep slopes in pine-oak forest outside of protected activity centers that have not been logged within the past 20 years, fuel accumulations should be treated to abate fire risk using combinations of thinning less than 9 inches in diameter, mechanical fuel removal, and prescribed fire. In addition, in these areas, clumps of broad-leafed woody vegetation and hardwood trees larger than 10 inches in diameter at root collar should be retained (1987 Plan, page 65-2). Within areas managed to have Mexican spotted owl nest/roost characteristics (10 percent of the area identified as restricted habitat), large oaks should be retained and promoted; pine-oak stands should maintain 20 square feet per acre of basal area of oak (1987 Plan, page 65-4). In areas identified as restricted habitat (outside of areas managed for nest/roost characteristics), the plan components would retain substantive amounts of hardwoods for retention, recruitment, and replacement of large hardwoods (1987 Plan, page 65-5). In other management areas, the direction for Gambel oak is generally that it should be present.

Direction for Gambel oak in Management Area 3 includes specific prescriptions to provide a balance of age classes, and provide a sustained yield of sprouts, mast, cavities, and foliage volume with the intent to improve wildlife habitat and provide firewood. Salvaging of dead, down oak is encouraged although oak showing obvious wildlife use would be retained (1987 Plan, page 131). This direction would apply to areas not managed for Mexican spotted owls and would be considered along with other overlapping direction, such as forestwide direction for northern goshawks.

As a shade-intolerant species, objectives that would create more open conditions and allow additional light to reach existing oaks would promote diameter growth. Furthermore, treatments that reduce fire intensity and severity would reduce the risk of loss of existing large oaks and avoid excessive recruitment of small-diameter oaks through sprouting. Alternative A has no forest plan objectives specifically for Gambel oak or for the ERUs within which it occurs. The anticipated level of mechanical treatment within the Ponderosa Pine ERU ranges between 50,000 acres and 260,500 acres every 10 years for the life of the plan. The greater the treatment level, the larger the proportion of the landscape that would be moved toward an open condition. This would reduce the risk of uncharacteristic fire and improve growing conditions for existing Gambel oak. Within the mixed conifer with frequent fire ERU, mechanical treatment is expected to occur across 2,900 acres every 10 years for the life of the plan. The 9-inch diameter cutting limit within PACs and steep slopes would limit the improvements within those areas; however, generally this would create more open conditions and benefit Gambel oak.

Alternative B (modified)

Under alternative B (modified), there is direction related to Gambel oak within the ponderosa pine and mixed conifer ERUs. Oak of various sizes should be present and well distributed in both the mixed

conifer ERU and the ponderosa pine-Gambel oak sub-ERU (FW-TerrERU-MC-MCFF-DC-1, FW-TerrERU-MC-All-DC-3, FW-TerrERU-PP-DC-3). Large oaks should be well-distributed at landscape scales within the ponderosa pine-oak subtype providing an important source of food and habitat for wildlife (FW-TerrERU-MC-All-DC-3, FW-TerrERU-PP-DC-15). Large oaks are recognized as a particularly important component of ponderosa pine old growth (FW-TerrERU-PP-G-4) and as a habitat component for Mexican spotted owl (see the general description of the ponderosa pine and mixed conifer ERUs).

Within the Mixed Conifer with Frequent Fire ERU, the action alternatives have mechanical treatment objectives that are approximately four times higher than those expected under alternative A. These treatments would move a much larger proportion of the landscape toward a more open condition, reducing the risk of uncharacteristic wildfire and directly improving growing conditions for Gambel oak. Within the Ponderosa Pine ERU, both alternative B (modified) and alternative A are expected to mechanically treat similar acreages annually, and as a result, are expected to have similar outcomes.

Alternative C

Alternative C does not differ from alternative B (modified).

Alternative D

Alternative D does not differ from alternative B (modified).

Alligator Juniper

Alternative A

Under alternative A, alligator juniper is discussed as a component of Ponderosa Pine and Pinyon Juniper Woodlands and direction is provided in three different management areas (Ponderosa Pine and Mixed Conifer less than 40 percent Slopes – MA 3, Unproductive Timber Land – MA6, and Pinyon-Juniper Woodland less than 40 percent Slopes – MA 7). Across all management areas, the direction is to manage alligator juniper primarily for maintaining and enhancing wildlife habitat (1987 Plan, pages 132, 147, and 154). To that end, the plan direction requires that at least 40 percent of the tree be retained, but allows that when junipers comprise greater than 50 percent of the total basal area, then junipers equal to or greater than 12 inches d.b.h. may be cut. In MA 7, clearcuts may be used when juniper regeneration is desired.

As a generally shade-intolerant species, objectives that would create more open conditions and allow additional light to reach existing junipers would promote diameter growth. Furthermore, treatments that reduce fire intensity and severity would reduce the risk of loss of existing large junipers and avoid excessive recruitment of small-diameter juniper through sprouting. Under this alternative, there are no treatment objectives for alligator juniper or for the ERUs within which it occurs.

The anticipated level of mechanical treatment within the Ponderosa Pine ERU ranges between 5,000 and 26,050 acres per year. Within the Pinyon Juniper with grass ERU the annual expected mechanical treatment is 100 acres. The greater the treatment level, the larger the proportion of the landscape that would be moved toward an open condition. This would reduce the risk of uncharacteristic fire and, when combined with prescribed fire, improve growing conditions for existing alligator juniper.

Alternative B (modified)

Alligator juniper is recognized to occur throughout not only all three Pinyon Juniper ERUs, but also within ponderosa pine and great basin grassland ERUs. Under alternative B (modified), there is direction that promotes a mosaic of vegetation conditions at a variety of scales across landscapes and watersheds and that provides desired species composition via natural and human disturbances (FW-TerrERU-All-DC 1,2). Plan language also promotes vegetation conditions that maintain biodiversity through inclusions,

landscape variability, and ecotones (FW-TerrERU-All-DC-4, G-1). Grassland direction promotes native plant species that are present in natural patterns of abundance and density and vegetation patches that vary based on site potential (FW-TerrERU-Grass-DC-1, 8). Pinyon juniper ERUs are described as having a mix of tree species and plan components promote trees distributed as individuals or smaller groups from young to old, reflecting natural disturbances (FW-TerrERU-PJ-DC-1, 6, 10). Collectively, these plan components would sustain inclusions of species such as alligator juniper at different scales. In addition, there is a management approach in TerrERU-All specific to considering inclusions and landscape variability during project planning.

As discussed under alternative A, open conditions favor alligator juniper. Under this alternative, there are objectives to mechanically treat between 50,000 and 260,500 acres every 10 years over the life of the plan within the Ponderosa Pine ERU; this should produce the same outcome as under alternative A. However, in the Pinyon Juniper with Grass ERU, the objective for mechanical treatment is between 1,000 and 10,000 acres every 10 years over the life of the plan. On the high end, this represents a 10-fold increase over alternative A; within this ERU, there should be greater improvement in the vegetation condition.

Alternative C
Alternative C does not differ from alternative B (modified).

Alternative D
Alternative D does not differ from alternative B (modified).

Blue Spruce
This species occurs rarely on the Coconino NF. Predominantly associated with moist sites, it is known to occur in the West Fork of Oak Creek, Volunteer Canyon, and Hochderffer Hills.

Alternative A
Under this alternative, a very general silvicultural prescription is provided that emphasizes the preservation of existing blue spruce stands (1987 Plan, page 132). There has been little to no management of blue spruce in the last 10 years, and the plan contains no treatment objectives, so management is not anticipated to change over current levels.

Alternative B (modified)
Under alternative B (modified), blue spruce is recognized as a component of riparian forest and mixed conifer ERUs. There is direction that promotes a mosaic of vegetation conditions at a variety of scales across landscapes and watersheds and that provides desired species composition via natural and human disturbances (FW-TerrERU-All-DC 1, 2). Plan language also promotes vegetation conditions that maintain biodiversity through inclusions, landscape variability and ecotones (FW-TerrERU-All-DC-4, G-1). Riparian direction promotes tree species of all ages and size classes necessary for the recruitment and succession of riparian-dependent species (FW-Rip-RipType-DC-1). Plan components in Spruce-Fir ERU support a functioning ecosystem that is composed of a mosaic of structural and seral stages ranging from young to old that is composed of multiple species, with plant composition similar to site potential, which can vary considerably at fine- and mid-scales owing to a diversity of seral stages (FW-TerrERU-SF-DC-1, 4). Collectively, these plan components would sustain inclusions of species such as blue spruce at different scales. In addition there is a management approach in TerrERU-All specific to considering inclusions and landscape variability during project planning.

There are no treatment objectives specifically for blue spruce or for the Spruce-Fir ERU in which blue spruce can occur; however, there are objectives to mechanically treat between 50,000 and 260,500 acres every 10 years over the life of the plan within the ponderosa pine ERU (FW-TerrERU-PP-O). Across the riparian forest types, there is an objective to restore the function of 200 to 500 acres of nonfunctioning

and functioning-at-risk riparian areas every 10 years during the life of the plan (FW-Rip-RipType-O). Alternative A has no such objectives, and as such, under the action alternatives, the condition of the riparian areas where blue spruce is found could be improved.

Alternative C

Alternative C does not differ from alternative B (modified).

Alternative D

Alternative D does not differ from alternative B (modified).

Cumulative Effects

Cumulative effects are the consequences of past and foreseeable activities on Federal and non-Federal lands that, in conjunction with direct or indirect effects from management activities likely to occur on the forest, may intensify, negate, improve, or otherwise affect the vegetation types, habitats, and species of the forest. Below are considerations of consequences of activities that would likely occur on adjacent or nearby ownerships to the forest.

The activities that would influence the cumulative effects in terms of vegetation would include invasive species treatments, prescribed fires, wildfires managed for resource objectives, timber sales, pre-commercial thinning, and other vegetation improvement projects. The geographic setting for the cumulative effects analysis includes all lands within the forest boundary and lands that are immediately adjacent to the forest boundary (e.g., some lands administered by the State of Arizona, the Walnut Canyon National Monument, and adjacent national forests). The timeframe for past actions is 20 years and 10 years for future and foreseeable projects.

Anticipated Activities on Adjacent Lands

Other Federal Lands

Several national forests in the immediate vicinity of the Coconino NF (Kaibab, Prescott, Apache-Sitgreaves, and Tonto National Forests) have revised or are in the process of revising their forest plans. All have placed an emphasis on the restoration of plant communities (ERUs). Activities associated with the new plans are expected to maintain or make progress toward desired conditions that are similar across the Southwestern Region; these activities include uneven-aged silvicultural treatments that ensure that all ages and sizes of trees are present throughout the landscape and fire treatments that reduce the potential for uncharacteristic fire behavior. Cumulatively, they would also promote a structure, composition, and pattern that is similar to historic conditions and also promote resilience to disturbances like insect outbreaks, wildfires, and a changing climate.

The Four-Forest Restoration Initiative is a planning effort designed to restore ponderosa pine forest resiliency and function across four national forests in Arizona including the Coconino, Kaibab, Apache-Sitgreaves, and Tonto National Forests. The initiative area has been divided into multiple environmental analyses including at least two large analyses. The first large analysis has been completed and covers over 980,000 acres spanning both the Coconino and Kaibab National Forests. Within this area, a suite of restoration treatments, including mechanical and fire treatments, has been analyzed on approximately 230,000 acres of the Kaibab NF and 355,000 acres of the Coconino NF. The second large analysis is currently underway, and is expected to analyze treatments that would restore the resiliency and function of ponderosa pine forests that span the southern portion of the Coconino NF and portions of the Apache-Sitgreaves and the Tonto National Forests. The restoration treatments occurring on the three partner national forests are expected to support and improve the positive outcomes of treatments on the Coconino

NF by increasing the scale of restoration and reducing the vegetation and fire return interval departure across a larger landscape.

The National Park Service General Management Plan for the Walnut Canyon National Monument establishes mission goals of maintaining and protecting natural resources. It authorizes mechanical thinning to reduce tree densities and prescribed fires to restore fire to its natural role in ponderosa pine stands. When implemented, these activities would reduce the risk of uncharacteristic fires and help restore the structure, composition, and function of vegetation communities. These outcomes would complement the management activities authorized under the revised Coconino Forest Plan.

The National Guard Bureau and Arizona Amy National Guard are in the process of reviewing Camp Navajo's Draft Integrated Resource Management Plan. The draft plan has many goals related to natural resource management, including: restoration of forest resiliency and function by moving toward re-establishment of historic forest, structure, pattern, and composition, restoration of fire to its natural role in the ecosystem, protection of vegetation communities, and management of wildlife habitat. Cumulatively, these actions would complement the management activities authorized under the revised Coconino Forest Plan.

State Lands

The Arizona Governor's Forest Health Council created a "Statewide Strategy for Restoring Arizona's Forests" which focuses attention on the current condition of Arizona forests and the steps required to restore their health and vigor (Governor's Forest Health Councils 2007). It describes approaches for achieving long-term ecosystem restoration, fire risk reduction around communities, natural fire management in wildlands, and the development of appropriate restoration-related economic opportunities. Based on sound ecological and social science, the statewide strategy incorporates valuable insights and techniques from the successful and innovative efforts already underway in Arizona. The primary purpose of the statewide strategy is to foster the implementation of a comprehensive, systematic effort to restore the ecological integrity of Arizona's forests and woodlands, while at the same time describing how rural communities can benefit from their aesthetic, ecological, and economic resources without compromising forest health and public safety.

Arizona State Land is interspersed throughout and adjacent to the Coconino NF. Those areas managed by the Arizona State Forestry Division are done so under their mission to manage and reduce wildfire risk to Arizona's people, communities, and wildland areas and provide forest resource stewardship through strategic implementation of forest health policies. The Forestry Division is expected to continue implementing mechanical and fire treatments that reduce tree density, restore the local vegetation structure and pattern, and reduce the risk of uncharacteristic fires (especially in the wildland-urban interface). These actions would complement the management activities authorized under the revised Coconino Forest Plan.

Arizona Game and Fish Department and the Arizona Department of Transportation both have plans that emphasize limiting the spread of invasive species including noxious weeds. It is expected that as a result of these various activities, there would be overall improvements in the departure of affected ERUs.

Arizona state trust land is managed by the Arizona State Land Department (AZSLD), which has been granted authority over all trust lands as well as the natural products they provide. This authority over trust land is central to the AZSLD's primary mission of maximizing revenues for its beneficiaries, a role that distinguishes it from other agencies charged with managing public lands (e.g., national parks, national forests, state parks). The AZSLD may dispose of (i.e., exchange) or lease the lands for natural resource use or commercial development purposes. The impacts of the lease or sale of any parcel of state trust land

adjacent to the Coconino NF cannot be anticipated, based on the information currently available. The AZSLD prepares a 5-year plan that represents potential areas of concern to initiate land sales and long-term leases. As of September 2016, this plan was not available (Arizona State Land Department 2016b).

Local Government Lands

The Coconino NF resides in three counties (Coconino, Yavapai, and Gila Counties), covering approximately 1.8 million acres. County or city comprehensive plans can be used as a source of information on the history of land use within the region, the patterns of development, desired conditions, and current county land use policies. County governments hold no legal authority over independent jurisdictions such as Federal and State lands, incorporated cities and towns, or Native American tribal reservations.

The Coconino County Comprehensive Plan (2015) serves as a long-range guide for the future, with goals that provide general direction, and policies that specify the location, form, purpose, and acceptable impacts of development. The plan focuses on three pillars of sustainability: environmental, economic, and social. The environmental pillar includes ecosystem services, air quality, water quantity and quality, open space, and climate change. No conflicts between the Coconino County goals and objectives and Coconino NF proposed plan components have been identified.

The Yavapai County Comprehensive Plan (2012) guiding vision is to provide a flexible and adaptable approach to managing growth while protecting a permanently sustainable natural environment. The "Environmental Element" of the plan addresses environmentally sensitive lands (primarily wetlands and riparian areas), wildlife habitat, invasive species, forest ecosystem health, and air quality. The comprehensive plan recognizes that the Forest Service manages approximately 38 percent of the land in Yavapai County and recommends that the county coordinate with public land agencies to improve forest health and "to create standards to protect Wildland/Urban Interface." No conflicts between the Yavapai County goals and objectives and Coconino NF proposed plan components have been identified.

The Flagstaff Regional Plan (2014) is a development and preservation guide for the city and its surrounding region. The plan contains 22 elements, to include open space and the environment; each element was carefully analyzed and subsequent goals were developed based upon public input and research. Goals and policies for all of the elements have been formally adopted by the Coconino County Board of Supervisors and Flagstaff City Council. No conflicts between the regional plan goals and the Coconino NF proposed plan components have been identified.

The Verde Valley Regional Land Use Plan (2006) established land use principles and advice for Verde Valley communities and addresses four primary topics, transportation, open space, housing, and land management agencies. It encourages cohesion and coordination between communities and across jurisdictions. The plan focuses on the management of undeveloped land and the intersection with housing and transportation. It does not provide clear direction in terms of how open spaces and natural areas are to be managed, but rather espouses a "balanced" approach and acknowledges the value of open space preservation. There is insufficient information in the regional plan to gauge its interaction with the Coconino NF proposed plan components.

Community wildfire protection plans have been developed for Yavapai County (2011) and for Flagstaff and its surrounding communities (2004). They emphasize treatments across multiple jurisdictions including Federal, State, county, and private lands that are within the wildland-urban interface; as a consequence, the risk of uncharacteristic wildfires to communities would be reduced.

Based on the revisions (or expected revisions) to the forest plans of neighboring national forests and the anticipated activities in throughout adjoining lands under other jurisdictions, there are no anticipated

negative cumulative effects to vegetation and fire return interval. Rather, it is expected that the cumulative environmental consequences, in the context of the surrounding area, would be either neutral to or would improve the identified trends of vegetation and fire return interval departure for all alternatives.

Climate Change

This section summarizes potential effects of climate change on forest resources, briefly assesses potential changes in greenhouse gas emissions from forest activities, and evaluates how well the alternatives mitigate climate change-related effects. More information may be found in the Southwestern Region Climate Change Trends and Forest Planning (USDA Forest Service 2010c) and Ecological Sustainability Report (USDA Forest Service 2009a). Climate change was also considered in the species viability analysis.

Affected Environment

Climate scientists agree that the Earth is undergoing a warming trend, and that human-caused elevations in atmospheric concentrations of carbon dioxide and other greenhouse gases are among the causes of global temperature increases. The observed concentrations of these greenhouse gases are projected to increase. Carbon dioxide can be emitted by numerous natural and human-caused activities and is both an emission and an input to ecological functions. These roles are often referred to as sources and sinks. Forests are a particularly challenging area of study when looking at carbon dioxide because the net contribution to storage of carbon or its release is dependent on a complicated and interrelated set of chemical and physical processes that provide energy for plants and wildlife and recycles nutrients through decomposition and disturbances such as fire. Currently, human-caused carbon dioxide emissions are not a regulated pollutant under the Clean Air Act.

The state of knowledge needed to address climate change at the forest scale is still evolving and has many uncertainties. Most global climate models are not yet precise enough to apply to land management at the ecoregional or forest scale. This limits regional and forest-specific analyses of potential effects from climate change. A recurrent trend in the literature suggests that predicting the future effects of climate change and subsequent challenges to land management in the Southwest remains inexact, and would no doubt require a combination of approaches.

Current Conditions and Future Trends

According to the 2010 Forest Service guide on Southwestern Region climate change trends and forest planning (USDA Forest Service 2010c), there appears to be broad agreement among climate modelers that the southwestern United States is experiencing a drying trend that may continue well into the latter part of the 21st century. Regional drying and temperature trends have occurred twice during the 20th century (such as the 1930s Dust Bowl and 1950s Southwest Drought) and may have been even more severe during what is known as the Medieval Climate Anomaly, an interval of warm, dry conditions with regional variability from A.D. 900 to 1350. According to model scenarios, the slight warming trend observed in the last 100 years in the Southwest may continue into the next century, with the greatest warming to occur during winter. These climate models depict temperatures rising approximately 4 to 5 degrees Fahrenheit (approximately 2 to 3 degrees Celsius) by 2030 and between 7 and 12 degrees Fahrenheit (4 and 7 degrees Celsius) by 2090. This trend would increase pressures on the region’s already limited water supplies, as well as increase energy demand, alter fire regimes and ecosystems, create risks for human health, and affect agriculture.

Climate may influence the distribution and abundance of plant and animal species through changes in resource availability, fecundity,[31] and survivorship. Natural disturbances having the greatest impacts on forests include insects, diseases, introduced species, fires, droughts, landslides, windstorms, and ice storms. Climate variability and changes can alter the frequency, intensity, timing, and spatial extent of these disturbances. Many potential consequences of future climate change are expected to be buffered by the resilience of forests to natural climatic variation. Literature suggests that new disturbance regimes under climate change are likely to result in significant perturbations to NFS lands, with lasting ecological and socioeconomic impacts. The potential ecological implications of climate change trends in the Southwest indicate:

- More extreme disturbance events, wildfires, intense rain and wind events, etc., combined with reduced frequency of rainfall or more frequent drought;
- Greater vulnerability to invasive species, including insects, plants, fungi, and vertebrates;
- Long-term shifts in vegetation and wildlife patterns;
- Decreases in net production;
- Cold-tolerant vegetation moving upslope or disappearing in some areas. Migration of some tree species north of their existing range; and
- Decreased winter precipitation and shifts in the timing of snowmelt.

Environmental Consequences

Common to All Alternatives

It is anticipated that treatments under all alternatives, especially those on the upper end of the objectives for alternatives B (modified), C, and D, would improve the net carbon balance on the forest. Emissions from a wildfire similar to the 2010 Schultz Fire were compared to a scenario where an area is thinned and burned and maintained by subsequent prescribed fire using the First Order Fire Effects Model. The modeling results showed that even though the thinning and burning only reduced emissions of carbon dioxide by 20 percent when compared to a wildfire, emissions of subsequent treatments would be reduced by more than 75 percent (Lata 2011). The improved ecological conditions that would result from areas being restored to their desired conditions and maintaining a fire regime consistent with historic fire return intervals would be expected to reduce the carbon dioxide emissions on the forest.

The potential geothermal resources on the forest may have a positive consequence to climate change in that geothermal is a renewable resource. All mineral development activities contribute to air quality effects and, in turn, may affect climate change. These effects can to some extent be mitigated by various pollution control systems and improved technology. As none of the alternatives directly authorize mining of any type, and alternatives B (modified), C, and D have the same desired conditions, guidelines, and management approaches, they all have the same potential contributions to climate change.

Under any alternative, management activities that would improve ecosystem function would likely improve the resiliency of those ecosystems to withstand changes in disturbance patterns, such as changes in frequency, intensity, timing, and spatial extent, as a result of climate change. Shifts in vegetation and habitat ranges as a result of long-term climatic changes, however, are outside of Forest Service control and not addressed by any plan alternative.

[31] Numbers of young produced during the course of an organism's life.

Alternative A

Alternative A would likely result in management that would not move toward consistent desired conditions or generate consistent and strategic responses to climate change effects on forest resources beyond what is directed by existing law, regulation, and policy. Because alternative A lacks consideration and plan direction relating to climate change, management of the forest with respect to climate change would be guided only by law, regulation, and agency policy. As a result, climate change responses would likely not be as well integrated and coordinated at the forest level.

Additionally, where this alternative lacks clearly articulated desired conditions and other plan guidance to promote ecosystem health and progress toward desired conditions (see other sections in chapter 3), those resources would be more vulnerable to disturbances, including climate change that could cause conditions to depart further from desired conditions.

The plan monitoring program does not include components to specifically monitor climate change. However, there are monitoring items that should help improve understanding of the relationships between key plan components and climate change. For example, monitoring items such as watershed condition and growth reduction and morality caused by insect and disease infestation would help the forest assess how well management is mitigating hotter and drier conditions that would increase the risk for uncharacteristic wildfire and increase susceptibility of trees to insects and disease.

Alternative B (modified)

Alternative B (modified) would emphasize the restoration and maintenance of ecosystem health through plan guidance and, therefore, forest conditions would be expected to be better able to withstand climate change related disturbances over time.

Climate change is addressed as an integrated part of alternative B (modified), rather than as a standalone set of desired conditions. The articulation of desired conditions in these alternatives, in particular, would focus management activities on natural resource conditions sought. For example, these alternatives include several desired conditions that expressly seek ecosystems that are resilient to natural climate . For example, see FW-Eco-DC-1, FW-TerrERU-DC-2, FW-TerrERU-PP-DC-2, FW-TerrERU-MC-MCFF-DC-4, FW-TerrERU-MCIF-DC-4, and FW-TerrERU-SF-DC-4. The nature of the plan to manage toward desired conditions regardless of current or changing conditions, such as climate change, is intended to allow management of the forest to adapt as necessary to continue moving toward ecological and social desired conditions.

Management approaches for All Terrestrial ERUs provides direction to help facilitate species movement to climate change. It states “In areas of high vulnerability to climate change, consider the following approaches to facilitate natural adaptation to changing conditions. Because many early-mid species or species characteristic of lower life zones are adapted for warmer and drier conditions, emphasize early-mid seral species or species from lower life zones over late-seral species and species of higher life zones.” This would allow plants from lower elevations to inhabit the areas currently occupied by species that generally require cooler and moister conditions as the climate warms and becomes drier, allowing them to survive as part of the vegetation community on the forest. The approach would benefit some but not all vegetation communities. For example, the Alpine Tundra ERU is especially vulnerable to climate change due to its isolated nature.

The guidance for soils contains specific language addressing climate change. FW-Soil-DC-2 states “soil productivity and functions contribute to the resiliency and adaptability of terrestrial and riparian ecosystems to climate change.” This would be achieved by providing for site-specific soil productivity and function that is resistant to forces such as erosion. The soils would provide a good foundation for healthy plant communities across the forest.

The Southwestern Region "Climate Change Trends and Forest Planning" guide (USDA Forest Service 2010c) identified five key climate change factors that can be addressed as part of a plan revision. Table 41 lists these key climate change factors and some of the more relevant plan direction in alternative B (modified) that addresses them. The factor related to resilient native ecosystems contains additional sub-factors (i.e., fragmentation, promote connectivity, riparian, and maintain diversity) that address wildlife and plant species that are dependent on forest ecosystems.

Table 41. Key climate change factors and relevant plan direction

Key Climate Change Factor	Relevant Plan Direction from Alternatives B (modified), C, and D
Enhance adaptation by anticipating and planning for disturbances from intense storms	MA-VerdeV-DC-1, SA-Wild-DC-4, MA-LkMry-G-1, MA-CCCrg-G-1, and a management approach in the Watershed and Water section
Reduce vulnerability by maintaining and restoring resilient native ecosystems	FW-Eco-DC-1, FW-Eco-DC-3, FW-Soil-DC-2, FW-Water-DC-1 to 3, FW-Rip-All-DC-5, FW-TerrERU-All-DC-2, FW-TerrERU-All-DC-4, FW-TerrERU-All-Management Approach, FW-TerrERU-DC-DC--2, FW-TerrERU-DC-DC-4, FW-TerrERU-Grass-DC-2, FW-TerrERU-PJ-G-3, FW-TerrERU-PP-DC-2, FW-TerrERU-PP-G-6, FW-TerrERU-MC-MCFF-DC-4, FW-TerrERU-MC-MCIF-DC-4, FW-TerrERU-SF-DC-4, FW-TerrERU-AT-DC-1, FW-WFP-DC-2, FW-WFP-DC-6, MA-InBsn-DC-1
Fragmentation	FW-Rip-Strm-Management Approach, FW-Rip-RipType-Management Approach, FW-TerrERU-Grass-DC-3, MA-PineBelt-DC-6, MA-PineBelt-DC-7, MA-PineBelt-DC-8, MA-LkMry-DC-4
Promote Connectivity	FW-Water-DC-4, FW-Rip-All-DC-3, FW-Rip-RipType-G-2, FW-TerrERU-All-DC-3, FW-TerrERU-Grass-DC-3, FW-TerrERU-Grass-DC-6, FW-TerrERU-Grass-Management Approach, FW-TerrERU-General Description and Background (stringers), FW-TerrERU-All-General Description and Background (stringers), FW-WFP-General Description and Background (corridors), FW-WFP-DC-6
Riparian	FW-Eco-DC-1 to 3, FW-Soil-DC-3, FW-Soil-G-1 to 3, FW-Water-DC-2 and 3, FW-Water-G-1 and 4, FW-Rip-All-G-3, FW-Rip-Strm-DC-1, FW-Rip-Strm-G-1
Maintain Biodiversity	FW-WFP-DC-1 and 2
Increase water conservation and plan for reductions in upland water sources	FW-Water-DC-2 to 6, FW-Water-G-3, FW-Water-Management Approaches
Anticipate increase in forest recreation use, utilize markets and demand for small-diameter wood and biomass for restoration, renewable energy, and carbon sequestration	FW-Rec-All-DC-6, FW-Rec-All-G-2, FW-Rec-All-Management Approach, FW-LndAdj-Management Approaches, FW-FProd, DC-1, FW-FProd-Management Approach
Monitor climate change influences	FW-SpecUse-DC-2, Monitoring Strategy Questions 6, 7, 8, and 9

Managing ecosystems under uncertainty necessitates flexible and adaptive approaches that are reversible, are implemented in incremental steps, which allow for new information and learning, and that can be modified with changing circumstances (Millar et al. 2007). The strategic and less prescriptive nature of the plan components included in alternative B (modified) would allow different management tools and activities, as well as new research to be considered in order to continue making progress toward stated desired conditions, even if climate change or other disturbances were to affect forest conditions during the life of the plan. Progress toward ecological desired conditions would increase the potential for ecosystems to maintain or return to desired conditions after being influenced by climate change related impacts and variability.

More generally, alternative B (modified) would track the forest's progress toward desired conditions and whether management activities are promoting resilient ecosystems. Like alternative A, the monitoring strategy for alternative B (modified) does not include components to specifically monitor climate change. However, there are monitoring items that should help improve understanding of the relationships between key plan components and climate change. For example, Monitoring Question 6 asks "[h]ow much have management activities contributed to reducing the risk of uncharacteristic fire?" Monitoring Question 7 asks "[h]ow much have management activities contributed to returning fire to fire-adapted ecosystems?"

Monitoring Question 8 asks "[h]ow much have management activities improved functional-at-risk or nonfunctional stream riparian areas and wetlands?" Monitoring Question 9 asks "[h]ow much have management activities contributed to the restoration of riparian function to springs not in proper functioning condition?" Question 14 asks "[t]To what extent are undesirable outbreaks of insects and pathogens occurring on the forest?" Questions like these would help the forest assess how well management is mitigating hotter and drier conditions that would increase the risk for uncharacteristic wildfire, impact vulnerable riparian areas, and increase susceptibility of trees to insects and disease. The Introduction to the Monitoring Strategy notes that the monitoring information would be evaluated when considering whether there have been any unanticipated changes in conditions and if those changes can be attributed to climate change.

Alternative C

Alternative C is the same as alternative B (modified).

Alternative D

Alternative C is the same as alternative B (modified).

Cumulative Effects

Climate change is a global phenomenon that has the potential to dramatically affect the natural resources found on the Coconino NF over the long term, as well as the social and economic amenities, such as recreation and forest products, that depend on those natural resources. Cumulative effects related to climate change were analyzed for the life of the plan (next 10 to 15 years) with consideration of long-term trends extending beyond that timeframe. The analysis area includes private, State, and Federal lands near and adjacent to the Coconino NF with climate change policies in effect.

Federal land management agencies have become increasingly aware of how climate change may affect public lands and are conducting research and coordinating management responses at many levels, often with partner organizations. Multiple branches of the Forest Service are engaged in developing tools and strategies for addressing climate change. For example, as part of its 2010 to 2015 strategic plan, the Forest Service launched a "Roadmap for Responding to Climate Change" (USDA Forest Service 2011a). This strategic plan should help the Forest Service better provide for sustainability over time with climate uncertainty. The roadmap focuses on three primary activity areas: (1) assessing current risks, vulnerabilities, policies, and gaps in knowledge; (2) engaging internal and external partners in seeking solutions; and (3) managing for resilience, in ecosystems as well as in human communities. More recently, the Forest Service published a guidebook for national forests to develop adaptation options to respond to climate change (USDA Forest Service 2011h).

There are also other State, municipal, and industry efforts, including Arizona's adoption of a renewable portfolio standard that promotes generation of electricity by renewable energy sources by 2025, that are aimed at reducing greenhouse gas emissions and associated effects of climate change over the long term. However, given the projected trends and persistence of climate change effects over the long term, effects of climate change on the Coconino NF can still be expected.

Because alternative A lacks consideration and plan direction relating to climate change, management of the forest with respect to climate change would be guided only by law, regulation, and Agency policy. As a result, climate change responses may not be as well integrated and coordinated at the forest level during the life of the plan (next 10 to 15 years).

Alternatives B (modified), C, and D are consistent with approaches of adjacent national forests that are also revising their forest plans with respect to climate change. By having consistent approaches for

addressing climate change, the ecosystems and species that depend on them should have a higher likelihood of persisting.

Recreation

This section evaluates and discloses the potential environmental consequences on recreation resources that may result with the adoption of a revised land management plan. It discusses recreation on the Coconino NF, which includes: the recreation setting, developed and dispersed recreation, and recreation special uses.

The Recreation Setting

Affected Environment

The recreation opportunity spectrum (ROS) is a framework that allows managers to describe and provide a variety of recreation opportunities (USDA Forest Service 1986). The desired ROS classes are identified in the forest plan and are used at the project level to demonstrate whether a proposed action moves the area away from or toward its desired condition for recreation settings.

The ROS defines six classes of outdoor recreation settings and experience opportunities. They are arranged along a spectrum, shown in figure 5. The black wedge in the figure represents the level of site development and social encounters, which increase from left to right. The spectrum describes a range of recreation opportunities, from a very high probability of solitude, self-reliance, challenge, and risk (that is, primitive) to highly developed environments where self-reliance, challenge, and risk are relatively unimportant (rural or urban) (USDA Forest Service 1986).

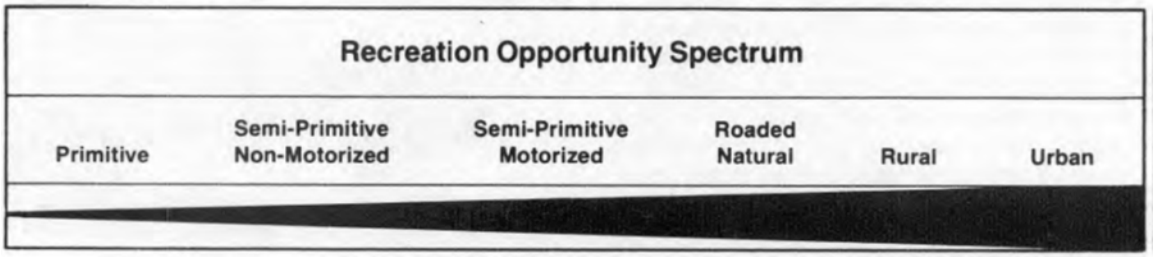


Figure 5. Recreation opportunity spectrum

In addition to describing the development level of each class, the ROS also describes the social setting. This is done by describing the number of social encounters a visitor may expect when recreating in a particular area. A “social encounter” is the number of people or groups of people outside an individual’s group that are met during a typical user’s experience in that area. ROS describes encounter levels qualitatively; where they are prescribed in forest plans they have been historically described in terms of encounters per day or per hour.

The forest plan sets the desired ROS (also called ROS objectives), which are used to determine if proposed projects are compatible with forest recreation goals. At the project level, it is used to determine if a project is moving an area toward or away from the desired ROS. In many cases, changes to the transportation system can have the biggest impact on ROS. For example, decommissioning a road may increase remoteness and non-motorized opportunities, while building a new road to provide access would increase opportunities in a more developed setting. The nature and type of facilities provided in an area also impacts the recreation setting. New campgrounds increase the development level and can change the ROS setting. The more facilities provide for comfort of the visitor, the more this is true. All projects that involve an active stage of construction or landscape alteration would have short-term impacts on the

recreation setting, but unless those impacts are evident over the long term, they would not require a plan amendment. For example, constructing a new trailhead would result in short-term ground disturbance, and would increase the presence of human activities at that location, but this concentration of use may ultimately result in a larger area with fewer human impact as people use the trailhead rather than dispersing up and down roadsides.

The 1987 forest plan identified ROS classes across the forest. Over time, the acres in each class changed as the result of land adjustments. However, ROS assignments have not been modified to reflect changes in management or visitor use. Therefore, the 1987 ROS reflects a snapshot in time and not the current existing condition.

In 2011, the Forest Service prepared an inventory of the physical, biological, social, and managerial settings on the Coconino NF and assessed which ROS class best represented these conditions (see table 42). A direct comparison between this inventory and the 1987 ROS is not possible, because the 1987 designations only include acres managed by the Forest Service. Many large tracts of ranch land outside of communities have been sold and subdivided, resulting in much more wildland-urban interface present today than in the past. The 2011 ROS inventory found that more of the forest was currently in a condition consistent with urban and rural classes than the 1987 plan recognizes.

Table 42. Percent of forest in recreation opportunity spectrum classes (per 2011 inventory)

Recreation Opportunity Spectrum Classes	Percent of Forest[1]
Urban	1
Rural	4
Roaded Natural (RN)	41
Semi-primitive Motorized (SPM)	37
Semi-primitive Non-motorized (SPNM)	17
Primitive	0

Source: Hill 2016

[1] Percentages are used for ROS throughout the report rather than acres because the inventory, alternative A, and alternatives B (modified), C, and D add up to different total acres because of the additional area that was allocated within the Sycamore Canyon Wilderness. This discrepancy was determined to be minor enough not to impact the comparison of alternatives because there is no wilderness opportunity spectrum calculation for the inventory.

The 2011 inventory found that over 70 percent of the forest was in a condition consistent with roaded natural (RN) or semi-primitive motorized (SPM) setting, meaning that on over two-thirds of the forest, there is a mix of developed and undeveloped settings in which roads are common or frequent features. The RN setting is where forest visitors typically find campgrounds and developed recreation settings, but there may still be many opportunities for dispersed recreation activities such as hiking, biking, and off-highway vehicle (OHV) riding. The SPM setting provides a similar physical setting with less-developed facilities like trailheads and lower encounter levels with other users (USDA Forest Service 1982a).

The next largest class on the forest is semi-primitive non-motorized (SPNM), which are areas that are more than a mile from a road. Primitive is a class that describes a very remote setting generally more than 3 miles from a road (USDA Forest Service 1982). By this strict definition, this classification is practically nonexistent on the Coconino NF outside of wilderness. Small portions of wilderness areas have a "primitive" setting (per the Wilderness Act definition), but did not meet the criteria for this ROS category on the Coconino NF because of their smaller size and the impacts of accessibility from roads along or near wilderness boundaries. See the "Recreation Opportunity Spectrum Inventory Report" (Hill 2016) for more information on how these delineations were made.

Increases in motorized uses (primarily 4-wheel drive and all-terrain vehicles) have resulted in somewhat less opportunity for some of the more "primitive" attributes, such as solitude and natural quiet in some areas, for example near popular recreation sites and adjacent to forest-bounded communities. Meanwhile, the decline in traditional timber activity and funding has resulted in less maintenance of the existing road system, creating more "primitive" roads because of deterioration. The gradual conversion of formerly well-maintained roads into more primitive roads has resulted in more routes for those seeking primitive roads to drive on. Management of recreation areas to ensure the presence of the more primitive settings in sufficient quantity to meet growing demand has been a challenge in the face of the growing population of visitors. According to surveys conducted by the Arizona State Parks, most Arizonans consider "open spaces in natural settings with very little development" and "large, nature-oriented parks with few buildings primarily used for hiking picnicking and camping" to be of highest importance to them (Arizona State Parks 2013). State surveys also indicated that the importance of these recreation settings decreases for recreationists participating in 4-wheel driving, OHV use and hunters, whereas the importance of such settings increases for day hikers, and those who walk, run, or job in parks or on trails (Arizona State Parks 2013).

Wilderness Recreation Opportunity Spectrum

The wilderness recreation opportunity spectrum (WOS) provides a way to describe variations in recreation settings within designated wilderness. There are four classes: Pristine, Primitive, Semi-Primitive, and Transition. Pristine settings are characterized by an extensive, unmodified environment where natural processes and conditions dominate and there is little to no evidence of human activity. Visitors face challenging conditions and must possess a high degree of self-reliance. Primitive areas have an essentially unmodified environment, where visitor concentrations are low and evidence of human use is minimal. Self-reliance and challenging conditions are common. Semi-primitive areas are largely unmodified, but there may be evidence of human uses or activities. Transition areas have a predominately unmodified environment, but concentrations of visitors may be moderate to high at some times or in some places. These areas often have large numbers of day users that may be mixed with overnight and long-distance travelers.

Environmental Consequences

Table 43 compares the difference in recreation opportunities by alternative and with the existing condition (alternative A). See the alternative sections that follow for further comparison.

Table 43. Percent of forest by recreation and wilderness opportunity spectrum settings

ROS Setting	1987 Forest Plan beginning Percent ROS[32]	Percent of Forest Existing Condition [33]	Alt. A[34] (%)	Alt. B Modified (%)	Alt. C (%)	Alt. D (%)
Urban	2	1	0	1	1	1
Rural	3	4	1	4	4	4
Roaded Natural (RN)	50	41	41	38	38	38
Semi-primitive Motorized (SPM)	38	37	36	38	37	38
Semi-primitive Non-motorized (SPNM)	4	17	6	11	8	11
Primitive	2	0	8	1	5	0
Wilderness: Transition (WT)	NA	NA	0	1	1	1
Wilderness: Semi-primitive (WSP)	NA	NA	0	2	2	2
Wilderness: Primitive (WP)	NA	NA	0	3	3	3
Wilderness: Pristine (WPS)	NA	NA	0	2	2	2

Common to All Alternatives

Because motorized big game retrieval occurs across a hunting unit regardless of ROS, the availability of motorized big game retrieval would not necessarily change because of ROS adjustments by the various alternatives. Areas that allow for cross-country motorized big game retrieval do not overlap management areas that emphasize reduced human-related disturbances, which is an element of alternative C. Accordingly, there should be no significant reduction or increase in this motorized recreation opportunity under any alternative. Likewise, there would be no significant increase or reduction in non-motorized recreation as it relates to motorized big game retrieval.

Alternative A

Alternative A would continue current ROS designations in the forest plan, as modified by land adjustments over time (see appendix A, map 4). Table 42 displays the differences between the existing ROS condition as determined by the 2011 ROS inventory and the ROS classes as set by alternative A. Alternative A would result in minimal changes in recreation opportunities being currently provided with the exception of SPNM. Alternative A would classify 6 percent of the lands managed by the forest as SPNM, whereas 17 percent of the lands within the administrative boundary of the forest were inventoried as SPNM in 2011. The other ROS classes would see minor changes.

The ROS for alternative A has the fewest acres in the SPNM setting of all the alternatives. At the time of the original inventory, the active timber program on the Coconino NF precluded many parts of the forest from being managed in this class. The road construction and management practices of this period were typically to build roads and then leave them for future timber sales. This practice increased road mileages on the landscape and precluded many areas that were suitable for timber sales from being considered for SPNM. The 2011 ROS inventory found that there are more locations on the forest with SPNM character

[32] 1987 ROS acres represent the total acres of the Coconino NF in that year, but are not the same as the amount used in 2011 and for alternatives A through D. This is not a precise comparison.
[33] 2011 Existing Condition ROS inventory.
[34] Alternative A includes just Forest Service managed lands (no state, private or other land jurisdictions), whereas alternatives B (modified), C, D include all lands within the administrative boundary. Accordingly, the acres included in the column for alternative A only refer to the 92 percent of the area within the Forest's administrative boundary that is managed by the forest.

currently than on the ROS objectives set by alternative A (see table 42 and table 43). This is especially true once roads were closed to the public through the "Coconino National Forest Motorized Travel Management Decision," and their presence on the landscape is diminished through lack of use or naturalization. Because these areas are now less developed than they were, alternative A would not protect their current naturalness and would allow for further future development of the recreation setting. This would not help to meet future expected trends for recreation in Arizona, because non-motorized activities and settings have the highest predicted demand indicating a supply gap for this opportunity. Managing for more developed recreation settings would widen that gap rather than meet expected demand.

Alternative A does not have an ROS that protects the setting of the Red Mountain Geological Area from motorized recreation or development. It is classified as Roaded Natural. Even though this is a special area and it has a motor vehicle closure order, there is no protection in the 1987 plan for the recreation setting provided by its designation.

Alternative A also has an error where it shows Kendrick Wilderness as Roaded Natural. The Wilderness Act overrides ROS, and so this error has no effect on the ground.

Under alternative A, 11 percent of the area currently having Semi-primitive Non-motorized qualities according to the 2011 ROS inventory (excluding wilderness) would be managed for a more developed recreation setting. This would increase the supply gap between the public's demand for undeveloped settings and plan direction for more development. The effect of this gap would be a decrease in the ability of the recreating public to find opportunities for quiet settings with low development, which would lead to decreased satisfaction in their recreation experiences.

Alternative A includes guidelines that address social encounter levels (1987 Plan, page 206-25 and 206-62). In the Sedona/Oak Creek Ecosystem-wide Management Area, a guideline directs forest managers to use a matrix as a guide for setting and managing encounter levels in each ROS class (1987 Plan, appendix M). Social encounters for Rural and Roaded Natural areas were set at 15 commercial tours per hour, with non-commercial encounters expected to be moderate to high frequency. Encounters for SPM, SPNM, and Primitive areas were set at 15 per day for all users (commercial and non-commercial). The 1987 plan defines an encounter as one vehicle or a group of six or fewer people. For example, if a hiker passed a group of 14 people on a trail, that would equal three encounters. If a recreationist encountered two jeeps on a road, that would equal two encounters. Some unusual situations could be allowed in some locations. These situations are described in the management areas in which they occur. For example, the Broken Arrow area is assigned an ROS class of SPM, but it is recognized that encounters along the road corridor will be more typical of those found in RN (1987 Plan, page 206-47).

In the Flagstaff/Lake Mary Ecosystem Analysis Area, a guideline directs forest managers to manage social encounters to meet ROS objectives (1987 Plan, 206-62). There are no social encounters levels set for Rural and Roaded Natural areas (1987 Plan, page 206-65). Encounters for SPM and SPNM were set at 15 per day for Forest Service permitted commercial tour operators (1987 Plan, page 206-65). Encounters for Primitive areas were set at 6 per day for Forest Service permitted commercial tour operators (1987 Plan, page 206-65).

The use of these numerical prescriptions for encounter objectives has become problematic in high-use areas. In 2015, the Red Rock Ranger District analyzed encounter level data for several trails and discovered that plan direction for encounter levels was exceeded throughout the management area. The forest lacks the management tools and ability to enforce the plan-prescribed encounter levels of 15 per day or 15 per hour. Therefore, under alternative A, recreation managers would have plan direction that was insufficient for the current situation on the ground. Social encounters would be out of compliance with plan direction for the entire management area. Residents, many of whom participated in the

development of the encounter levels, expect the Forest Service to manage use at these levels, which is unrealistic as tourism grows. This creates frustration and increasing conflicts with other, tourism-based user groups.

Alternative B (modified)

Alternative B (modified) is based on the 2011 inventory. However, it differs from alternative A, because it assigns an ROS class on all lands within the administrative boundary of the forest, regardless of ownership (see appendix A, maps 5 to 7). This means that an additional 172,226 acres of lands in State or local government or private ownerships are being analyzed as part of this alternative. The forest plan does not have any authority over these lands, but it is beneficial to identify recreation opportunities on these lands so as to maintain a compatible recreation setting across jurisdictional boundaries. Over 85 percent of these lands were classified as Urban, Rural or Roaded Natural, which is typical for the level of development found on private land. Alternative B (modified) more accurately reflects the areas that have a Rural or Urban setting on the Forest and the adjacent lands when compared with alternative A. The amount of Rural ROS class more than doubles in this alternative.

Table 43 displays the differences between the existing ROS condition as determined by the 2011 ROS inventory and the ROS classes as set by alternative B (modified). The biggest difference is that the SPNM ROS class would be reduced from 17 to 11 percent. The 1 percent increase in Primitive ROS reflects alternative B (modified)'s inclusion of three recommend wilderness areas. Under alternative B (modified), approximately 81 percent of the land within the administrative boundary of the forest would provide for more developed and motorized recreation opportunities (Urban, Rural, Roaded Natural, Semi-primitive Motorized). This is similar to the 83 percent that was identified by the 2011 ROS inventory and the 79 percent of the forest that would be in one of the ROS classes that provides for more developed and motorized recreation opportunities under alternative A.

There is also a change to RN settings in the Verde Valley north of Cottonwood. The communities in that area have had rapid population growth in the last 20 years, and their growth has increased the area's recreation use. Changing the ROS from SPM to RN in this area would not necessarily change the natural-appearing landscape of the area, but would allow for more developments to provide recreation facilities and public services to the local community.

Alternative B (modified) better reflects the work that has been done to manage the effects of roads on recreation and the natural setting in these areas by classifying more watershed acres as SPM and SPNM. The effect of this allocation would be to preserve the more semi-primitive, and in some cases non-motorized, setting in these areas. This is likely to result in some reduction in motorized access for hunters, campers, and motorized recreationists. Access to lakes and rivers in these areas would not be reduced, and management would not be changed by this direction. Off-road driving in these areas is already prohibited by the Travel Management decision (USDA Forest Service 2011g). Dispersed camping and recreation opportunities are limited in some locations to protect natural resources and to provide for public health and safety.

The ROS settings for the amendment 12 area have been largely retained. There are some differences between it and alternative A. The changes largely recognize the increase in visitor use and development of recreation sites that provide for safety and sanitation and protection of natural resources. Alternative B (modified) refines the locations of ROS boundaries. It recognizes the growth and expansion of communities and classifies these as Rural instead of Roaded Natural.

The ROS settings for amendment 17 have been modified, as well, to show more Urban and Rural reflecting the growth and development of Flagstaff. Roaded Natural areas have been changed to Rural to acknowledge growth and increasing wildland-urban interface of communities such as Bellmont,

Mountainaire, Kachina Village, Munds Park, and Mormon Lake. In addition, there are developed settings in areas influenced by utility corridors. This change would not have a measureable effect on the recreation setting and would more accurately affect the on-the-ground needs of managing both the special-use permit and recreation on the same piece of land.

The percentage of the forest that would be managed for an SPNM setting is greater than in alternative A, but smaller than the 2011 ROS inventory. One reason for the increase is the recommendation of several new special areas: one geological and botanical area and three new research natural areas.

Primitive ROS outside of wilderness areas in alternative B (modified) mostly represents the ROS classification of the three recommended wilderness areas (see "Designated Special Areas" for a description of effects). Just over 8,700 acres are proposed as recommended wilderness in alternative B (modified) and would provide additional primitive recreation opportunities. These areas would be managed for wilderness characteristics until the recommended wilderness areas are designated by Congress. Some activities such as mechanized use and motorized game retrieval could still occur at Abineau and Daveys recommended wilderness areas. If these uses were to impact these wilderness character at some point in the future, from new user created routes, loss of solitude or increasing erosion in the area, or other activities that would be inconsistent with the desired conditions, additional management actions could be taken or the areas could be closed to these activities as appropriate. The Strawberry Crater addition recommended wilderness has a closure order preventing these uses. Managing for alternative B (modified)'s objectives would better protect the unroaded and remote character of potential wilderness, but would not increase more primitive opportunities as much as alternative C.

The WOS classes in alternative B (modified) were modeled to provide for the greatest number of uses and wilderness values while allowing for management to be tactically dynamic in areas of higher use for the protection of the natural and wild character. Designation of wilderness transition (WT) and wilderness: semi-primitive (WSP) are more concentrated in areas of higher visitation and near wilderness boundaries. Areas within wilderness that are less accessible and offer higher opportunities for challenge, risk, exploration, and solitude are allocated to wilderness: primitive (WP) and wilderness: pristine (WPS) Through all four wilderness opportunity spectrum classes under alternative B (modified), each wilderness area would manage "human use and influences to preserve naturalness and solitude," while at the same time promoting the most pristine condition possible for the wilderness resource (Hendee and Dawson 2001).

While the ROS settings for the amendment 12 and 17 areas (Sedona-Oak Creek and Flagstaff-Lake Mary areas) have been largely retained, the guidelines related to social encounter objectives have been adjusted in several ways for alternative B (modified). Under this alternative, the social encounter direction has been crafted as a forestwide desired condition (FW-Rec-All-DC-4). This desired condition eliminates numerical prescriptions for encounters and instead applies a more qualitative description of the social settings visitors are likely to experience. Rather than hinging on a hard numerical limit that would be impossible to manage to, social settings are more descriptive and representative of the experience one may find. While conflicts may still occur between residents and tourism-based visitors, this more descriptive approach informs residents of what to more reasonably expect. This, in turn, would reduce their frustration as recreational use increases.

Alternative C

The effects of alternative C are largely the same as those for alternative B (modified). The exception is that alternative C would provide a greater increase in the number of acres designated as Primitive. This is due to the inclusion of 13 proposed wilderness areas.

This alternative would make the most progress toward meeting the demand for more wilderness opportunities, areas with reduced human-related disturbance, and non-motorized settings, and conversely, would provide the largest reduction of acres available to motorized recreation activities of any of the alternatives. This would balance the increasing development of recreation settings as other areas are classified as Rural, Roaded Natural, or Semi-primitive Motorized. It would ensure the balance of more- and less-developed opportunities for recreational users. When visitors are able to find sufficient access to the types of experiences they seek, their satisfaction increases.

Alternative D

The effects of alternative D are the same as those for alternative B (modified).

Recreation Activities and Facilities

Affected Environment

Recreation Activities and Facilities

Although recreational use on NFS lands has increased steadily since the establishment of the Forest Service, reports showed a decline in recreation participation nationally beginning in 2001. Reasons suggested for this trend include travel concerns following the September 11, 2001 attack on the World Trade Center and the expansion of indoor recreation opportunities through the growth of computer games, the Internet, and television (Roper 2004). Another factor contributing to declining outdoor recreation is the economic downturn starting in 2009.

National Visitor Use Monitoring (NVUM) survey data for the Coconino NF confirm that the forest is experiencing a similar slight decrease in recreation use, with the exception of visitations to wilderness areas, which have increased (see table 44). Even though these surveys show decreasing use forestwide, there may be locations on the forest where recreation use has increased on a more localized level. NVUM only accounts for trends at the forestwide scale. The five main activities drawing visitors to the Coconino NF were hiking/walking (32 percent of participants), viewing natural features (23.7 percent of participants), relaxing (7.1 percent of participants), driving for pleasure (3.5 percent of participants), and visiting historic sites (3.2 percent of participants). Downhill skiing, bicycling, fishing, and viewing wildlife were also very popular activities. The survey also estimated that approximately 60 percent of visitors to the Coconino NF traveled more than 100 miles for their visit, of which 30 percent traveled more than 500 miles (USDA Forest Service 2016n). This fairly large percentage of long-distance tourism in the visitation estimates may be another factor in the decline of overall visitation to the Coconino NF, as during economic downturns, people are less likely to spend money on long-distance travel and more likely to recreate or seek vacation experiences locally.

Table 44. National visitor use monitoring survey visitation estimates 2005 and 2010[1]

Type of Area	FY 2005 Site Visits	FY 2010 Site Visits
Day-use developed	2,308,000	2,244,000
Overnight use developed	148,000	128,000
Undeveloped general forest area	2,700,000	1,842,000**
Wilderness	384,000	501,000

Source: USDA Forest Service 2016m, 2016n

[1] The 2005 estimates were reconciled in 2016 to make them comparable because of a change in the modeling assumptions and methodology for the 2010 data.

[2] This decline may be partially due to outliers in the sampling of low-use days in general forest areas. For example, in 2005, Airport Saddle had a very large count on 2 days of 200 and 900 trips counted out of a sample of 12. In 2010, 40 days were sampled from this strata with 2 outliers of 100 and 300 trips counted. The magnitude and relative weight of these outliers may have skewed the 2005 estimates for general forest areas to be higher than actual use.

The Coconino NF has long been a destination for snow-based recreation because of its proximity to the growing populations of the Verde Valley and Phoenix metropolitan area, neither of which typically receives snow in winter. The Coconino, Kaibab, and Apache-Sitgreaves National Forests provide the majority of snowplay opportunities in Arizona. These activities include: skiing, snowboarding, cross-country skiing, snowshoeing, sledding, and general snowplay. Arizona Snowbowl, the Flagstaff Nordic Center, and Wing Mountain Snow-Play areas are privately managed facilities on the forest that supply much of the demand for developed snowplay facilities. A survey of snowplay visitors found that approximately 93 percent of respondents were from other counties in Arizona, primarily Phoenix, with an approximate contribution of $534 per group to the economy per trip (median group of 4 people). The estimated impact of these activities on local economies is $16.2 million annually (Flagstaff Convention and Visitors Bureau 2010). Often, demand for snowplay opportunities exceeds what the Coconino NF can provide as evidenced by long lines of vehicles waiting at snowplay facilities on snowy weekends (USDA Forest Service 2008a).

Table 45 shows the percent distribution of site types on the forest. The number of people accommodated at a particular site varies, for example, snowplay and ski areas represent 6 percent of site types, but the Arizona Snowbowl Ski Area has the most capacity to accommodate people. Trailheads represent almost half of the site types, and their parking capacity can range from 3 to 5 cars up to over 30 cars. Overnight facilities that provide trash cans and toilet facilities can help trash and sanitation issues, but the forest often struggles to provide satisfactory services with limited budgets. For this reason, about 35 percent of developed sites on the forest are managed by private companies or concessionaires or charge fees to operate and maintain the sites (USDA Forest Service 2017a). Concessionaires tend to manage larger sites, fee sites vary from smaller day-use areas to campgrounds.

Table 45. Developed facilities on the Coconino NF by type

Type of Facility	Percent of Forest Recreation Capacity
Water-based recreation site	13
Group sites, resorts, recreation residences	2
Campgrounds	14
Trailhead	45
Snowplay and ski areas	6
Day-use sites	15
Visitor information	3
Cultural heritage sites	2
Total	**100**

Source: USDA Forest Service 2017a

Many new recreation activities have emerged or increased dramatically in recent decades. They include: rock climbing, geocaching, downhill mountain biking, and paint balling (USDA Forest Service 2008a). Many of these emerging uses do not yet have agency standards for safety and management. As the forest attempts to manage these uses, the social trails and other impacts from these activities have the potential to create an even larger impact on the natural environment setting. The diversity of outdoor recreation activities, population and tourism growth, and challenges associated with educating the public on recreating responsibly has made sustainable management of the recreation resource difficult.

Environmental Consequences

Alternative A

The existing plan contains very little direction on managing recreation activities or developed sites. The two exceptions to this information gap are amendments 12 and 17, which address these concerns in the areas of the forest most affected by tourism and population growth (in and around the communities of Sedona and Flagstaff). The consequence of this lack of direction has been an inconsistent approach to recreation management on the forest. It is difficult for forest managers to identify suitable projects and avoid potentially incompatible activities. Inconsistent management makes it difficult for visitors to anticipate the availability and condition of recreation facilities from one district to another. Additionally, the lack of recreation direction in the 1987 Plan indicates that the public need for various types of recreation facilities or experiences was not considered in depth. When experience is mismatched to expectations or needs, visitors become dissatisfied with their overall recreation experience on the forest.

The bulk of amendments 12 and 17 direction for developed recreation is comprised of lists of specific construction and reconstruction projects for recreation sites and trails. Most of these projects have been completed, are not feasible due to lack of funding, or are no longer desirable due to changes in the recreation demand on the forest. This, plus the lack of a more general framework, outlining recreation broader desired conditions for recreation on the forest, renders the direction for developed recreation essentially moot. Without an understanding of the goals of recreation on the forest, managers would implement individual projects as they arise and without considering how they fit into a broader context of recreation as a whole.

For the majority of the forest, alternative A identifies management areas primarily based on vegetation and slopes. This method does not consider recreation use patterns and needs. Management areas that are inappropriate with regard to recreation management results in direction that may not align with recreation needs. Amendments 12 and 17 were designed to rectify this situation, by developing management areas based on recreation use and issues in Sedona and Flagstaff, where recreation on the forest is most concentrated. In addition to providing better descriptions of desired conditions for recreation, these amendments provide direction on coordinating forest management with community goals and across jurisdictional boundaries. As a result, recreation opportunities across ownership boundaries are more consistent and have fewer conflicts in the Flagstaff and Sedona areas. Under alternative A, the rest of the forest would lack structured direction. Managers would not be provided the framework to coordinate with communities and would not have to consider the character or consistency of recreation uses and developments with adjacent lands or goals. As a result, resident–user conflicts would be higher. The inconsistent approach to recreation issues on the forest would continue.

In summary, alternative A does not provide sufficient direction to manage developed recreation that is consistent across the forest and that meets the visitors' needs. The effect of inconsistent management would be a disparity between visitor expectations and experience and dissatisfaction with recreation facilities on the forest. As a result, people would seek opportunities in other parts of the forest, which may not be managed for recreation uses. This would result in increased negative impacts to natural resources, such as soil compaction and vegetation removal.

Alternative A does not address the use of fee programs and concessionaires as a strategy for managing the recreation resource, because many of these programs did not exist when the original plan was approved. In light of decreasing recreation budgets and increasing recreation demand, it is likely that such programs would play an increasingly important role in achieving the services and improvements dictated in the 1987 plan. However, the lack of a clear strategy would likely result in these programs being applied inconsistently and not being utilized to their fullest possibility. This would decrease the financial

sustainability of managing developed sites, which would result the forest being unable to keep pace with deferred maintenance needs. As facilities age, they may become unsafe for public use.

Alternative B (modified)

Alternative B (modified) acknowledges the changing demands for recreation activities on the Coconino NF and provides a management approach that reminds managers to analyze capacity for dispersed recreation activities in order to prevent overuse and degradation of natural resources and recreation settings (FW-Rec-Trails-Management Approach). This would result in restrictions on certain activities on particular trails or in certain areas as the plan is implemented. Conversely, it could also result in new areas or trails being established in order to concentrate use away from sensitive resources and avoid user conflict. While this would displace some recreation users from areas that they have historically used, it would allow the forest to retain ROS settings and proactively prevent degradation of recreation settings and sensitive wildlife habitat. Areas on the forest that are managed for higher encounter levels may see disproportionate increases in use as a result. However, because those areas are already managed for higher use levels, the impacts to visitor experience would likely be negligible. It is possible that managers would eventually need to consider expanding visitor facilities – such as parking areas or bathrooms – to accommodate this increased use over time.

The desired conditions for developed recreation facilities focus on the provision of a spectrum of recreation opportunities (FW-Rec-All-DC-4) balanced with the capacity of the forest to support these in a sustainable manner (FW-Rec-All-DC-6). Applying this strategy across the forest would result in concentration of visitor use at developed recreation sites, with increases in the number of amenities at these sites to accommodate increased use. Some sites may be redesigned from overnight to day use opportunities, which would allow for greater site turn over during the course of a day. This would allow more visitors to enjoy the developed sites, and it would increase the profitability as fee or concessionaire sites because of economies of scale. Some overnight developed facilities would continue to be provided. Designating additional locations for use as developed group-use sites would meet the need to provide opportunities for these uses while protecting natural resources. Currently, many larger groups use general forest areas, where their presence can result in resource impacts such as soil compaction, erosion, loss of vegetation, and disturbance to wildlife. Identifying locations for more developed sites where these activities can occur reduces these impacts, because the sites can be designed so as to mitigate them (e.g., prehardened ground, located away from sensitive riparian areas, etc.).

Even though the plan desired conditions are divided into developed and dispersed recreation categories, both sections provide direction to consider each resource as part of a larger landscape and recreation experience. The desired conditions for developed sites state that trails should link these sites to a variety of dispersed opportunities (FW-Rec-Dev-DC-6). The plan would also include direction on how to manage the quality, benefits, and impacts of interpretive and educational materials and kiosks in a variety of settings (FW-Rec-InterpEd-DC-2, 3, 4, 5). This direction would result in a more holistic approach to the recreation resource and a more gradual and planned mosaic of dispersed to developed settings based on use patterns and resource goals. This strategy would improve the quality of these settings, as management would have a more thoughtful and integrated approach in maintaining them. As a result, visitor experience would be improved, due to sites better meeting their visitor needs and expectations. Additionally, having quality opportunities that meet visitor needs reduces the likelihood that visitors will disperse to other areas. Focusing recreation use in areas specifically managed for it reduces the impacts of recreation use on resources in areas that may not have sufficient recreation facilities or development.

Alternative B (modified) has a management approach to address the use of fees, other funds, and partners to maintain or replace facilities (FW-Rec-Dev-MgtApp). It also suggests a mix of fee areas and special use permits (such as concessionaires) as funding mechanisms for sustainable operations and maintenance

of some recreation facilities (FW-Rec-Dev-MgtApp). This does not compel the forest to turn all such sites into fee areas, but it does provide a strategic way to manage those areas that would be most appropriate to consider for fees. These would typically be sites receiving high levels of use, which require increased amenities (such as trash management, restroom facilities, etc.) and the increased operation and maintenance costs associated with them. Using partners or fees to manage these areas increases the forest's ability to achieve the desired conditions at these sites, by providing funding or manpower to maintain facilities, increase enforcement, and mitigate or reduce impacts such a soil compaction or vegetation loss. This alternative could result in an increased number of fee or concession-managed sites, which would likely result in some visitors choosing to recreate elsewhere on the forest to avoid paying fees. This could result in increased damage to natural resources (soil compaction, vegetation loss, increased trash) as people recreate in areas that are not managed for recreation use. The forest could mitigate this by ensuring there are sufficient fee-free areas meeting the public's desired opportunities and by increasing public awareness of where those areas are located.

There are several major roads (such as Forest Highway 3, State Highway 89A, State Highway 87, and U.S. Highway 180) on the forest that experience high levels of recreational use and through traffic. While the roads themselves are managed by State or county agencies, the natural resources along the roads are managed by the Forest Service. Alternative B (modified) emphasizes the provision of developed facilities along these routes, as opposed to low-development trailheads or simple pullouts (SA-ScenicRds-DC-4, FW-Rec-Trails-DC-3, 10). Providing developed facilities in these areas would result in increased safety to both drivers and visitors, as they would provide greater distance and barriers between recreationists and high-speed traffic.

Guidelines for the construction and reconstruction of developed, dispersed recreation, and trails would not prescribe specific projects. Guidelines for developed recreation provide direction for the management and design of facilities to meet safety standards (FW-Rec-Dev-G-1) and to remain consistent with scenic integrity objectives (FW-Scenic-G-1). The provision of a management framework rather than a list of specific projects would result in increased flexibility in meeting demand for recreation facilities for the public. Structures would be visually compatible with the landscape and consistent in appearance across management areas through the application of the Forest Service "Built Environment Image Guide" and the desired landscape character descriptions (FW-Scenic-DC-7, 8, 9). Management approaches would encourage the determination of use trends when updating developed sites (FW-Rec-Dev-MgtApp). This would result in recreation developments responsive to seasonal demand, emerging recreation activities, and current best practices, plus a more sustainable approach to recreation developments.

Alternative C

The effects to recreation facilities under alternative C are the same as under alternative B (modified).

Alternative D

The effects to recreation facilities under alternative D are the same as under alternative B (modified).

Non-motorized and Motorized Recreation

Affected Environment

Non-motorized Recreation

Almost half of recreationists on the Coconino seek undeveloped forest settings in which to engage in recreation activities. These include activities such as hiking, camping, hunting, fishing, recreational shooting, horseback riding, mountain biking, rock climbing, nature study, visiting historic/prehistoric sites, and motorized vehicle recreation. In most places no facilities are provided. In areas of concentrated

use, limited facilities may be provided to protect resources. This may include parking, information kiosks, or, occasionally, toilets.

A diverse group of recreation activities take place, some of which have emerged during the past decade. These include: rock climbing, geo-caching, downhill mountain biking, and paint balling (USDA Forest Service 2008a). Many of these emerging uses do not yet have standards for safety and management. In addition, providing specific areas or trails for a large and diverse set of activities diminishes the natural environment setting. If left unmanaged, however, the social trails created by these users and resulting impacts on the areas have the potential to create an even larger impact on the natural environment setting. The diversity of outdoor recreation, population and tourism growth, and challenges associated with environmental education has made the management of a sustainable trail system difficult. Social trails have proliferated in the forest adjacent to urban areas, near subdivisions with common Forest Service boundaries, and in particularly desirable landscapes such as red rock country. Social trails can increase erosion and decrease vegetative cover, resulting in impacts to heritage sites, watershed conditions, wetlands resources, wildlife, and the overall trail experience. In some locations demand for particular recreation experiences has not been met. In other locations where dispersed camping is common, these are additional activities being engaged in while camping. Even though the most common places to find these impacts is near communities, popular dispersed camping sites such as Jacks Canyon also have webs of trails created by large and frequent camp use (Dechter, S., personal communication, June 17–22, 2011).

The Coconino NF has long been a destination for snow-based recreation because of its proximity to the growing populations of the Verde Valley and Phoenix metropolitan area, neither of which typically receives snow in winter. The Coconino, Kaibab, and the Apache-Sitgreaves National Forests provide the majority of snowplay opportunities in Arizona. These activities include: skiing, snowboarding, cross-country skiing, snowshoeing, sledding, snowmobiling, and general snowplay.

Motorized Recreation

Motorized recreation opportunities are available in most areas of the forest and are depicted on the motor vehicle use map and over-snow vehicle use map. They include designated camping corridors and big game retrieval. Additional opportunities for motorized dispersed recreation are also available on non-forest lands, such as the Observatory Mesa Open Space. Collaborating with and sharing information from other State and Federal agencies and municipalities will help to increase the variety of opportunities available for dispersed motorized recreation seekers.

The Coconino NF has a number of designated scenic roads. These include Historic Route 66 All-American Road and Red Rock All-American Road (nationally designated scenic byways) and two Arizona scenic roads, San Francisco Peaks and Sedona-Oak Creek Scenic Roads, all of which cross the Coconino NF. There are several major roads (e.g., Forest Highway 3, State Highway 89A, State Highway 87, and U.S. Highway 180) that are not designated scenic byways, but provide scenic driving experiences and experience high levels of recreational use and through traffic. While the roads themselves are managed by State or county agencies, the resources along the road are managed by the Forest Service.

The National Survey of Recreation and Environment in 2000 found that driving off-road (a category somewhat broader than off-highway vehicle use, but which captures the same population) grew in popularity by approximately 10 million respondents in the late 1990s and accounted for the activities of nearly 18 percent of respondents in 2000 (USDA Forest Service 2002a). National Visitor Use Monitoring survey data specific to the Coconino NF estimated only about 6 percent of forest visitors participating in off-highway vehicle activities, with less than 1 percent having off-highway vehicle activities as their primary purpose (USDA Forest Service 2016k). However, the National Visitor Use Monitoring program tends to focus more on developed sites, and Coconino NF personnel have observed that much of the off-highway-vehicle use is found in more dispersed locations. Therefore, it is possible that the Coconino-

specific National Visitor Use Monitoring program survey is underestimating actual off-highway-vehicle use on the forest.

A study funded by Arizona State Parks in 2003 found that Coconino and Yavapai Counties combined receive 2.36 million days of off-highway-vehicle recreation annually, with much of that use presumably occurring on local NFS lands (that is Coconino, Kaibab, and Prescott National Forests). This use represents 26 percent of total off-highway-vehicle use recorded in Arizona annually; 80 percent of Coconino County off-highway-vehicle use, and 35 percent of Yavapai County off-highway-vehicle use comes from areas outside those counties (Arizona State Parks 2003).

Most motorized recreation on the Coconino NF occurs on roads and in the Cinder Hills Off-highway Vehicle Area, which is managed for cross-country motorized recreation. The 2014 motor vehicle use map associated with the "Coconino NF Travel Management Decision" (USDA Forest Service 2011g) designated 604.9 miles of roads open only to highway-legal vehicles and 2,546.5 miles of roads open to all motorized vehicles, including off-road vehicles such as motorcycles, OHVs, ATVs, and AT-CTs). Additionally, there are 7.8 miles of designated motorized trails on the forest. Altogether, there are nearly 4,000 miles of road open to motorized recreation. (See table 46.) The motor vehicle use map also identifies opportunities for motorized dispersed recreation (motorized camping corridors and big game retrieval). The over-snow vehicle use map designates where over-snow vehicle use is permitted and prohibited. Trails and roads typically provide different recreation experiences, because they are maintained and designed differently and have different vegetation clearance requirements. Motorized recreation on roads and trails, as well as over-snow vehicle use, would continue across the forest under all alternatives in accordance with the motor vehicle use map and over-snow vehicle map developed under the Travel Management Decision.

Table 46. Miles of vehicle-type designations on the 2014 motor vehicle use map

Jurisdiction	Route Designation	Miles
Forest Service	All vehicles (yearlong and seasonal)	2,546.5
	Highway-legal vehicles (yearlong and seasonal)	604.9
	Motorized trails	7.8
Forest Service Total		3,159.2
Other	All vehicles	3.1
	Highway-legal vehicles	773.3
Other Total		776.4
Grand Total		**3,935.6**

Source: USDA Forest Service 2014a

Environmental Consequences

Alternative A

Alternative A includes schedules to undertake a variety of activities that would support non-motorized and motorized recreation. These activities include recreation site development (1987 Plan, page 242-11), trail construction and reconstruction (1987 Plan, page 242-12), arterial and collector road reconstruction and upgrade (1987 Plan, page 242-12 to 242-16), and campground and developed recreation roads (1987 Plan, page 242-17 to 242-18). These schedules of activities are outdated. Some of these have been accomplished and others would lead to conflicts with current law, regulation, and policy. These schedules no longer reflect the management needs of non-motorized and motorized recreation on the forest and,

therefore, provide no strategic value on how to manage areas for these activities. They also would not provide direction for the forest to respond appropriately to changing recreation demands.

Three seasonal closure areas on the Coconino NF were established before the 1987 plan: Pine Grove, Woods, and Rattlesnake (comprising approximately 40,658 acres). These areas are open to motorized travel in the spring and summer, but they are closed in the fall and winter to provide for non-motorized hunting opportunities. These areas would continue to be managed this way under this alternative. This direction would balance the demand for motorized recreation with demand for low disturbance environments for hunting and wildlife over the winter.

Recreational shooting (not to be confused with hunting) is not restricted under alternative A. However, there are restrictions in the Code of Federal Regulations (CFR) that apply to NFS lands. 36 CFR 261.10(d)(1) restricts shooting 150 yards from a residence, building, campsite, developed recreation site or occupied area. In addition, 36 CFR 261.10(d)(2) restricts shooting across or on an NFS road or body of water adjacent to an NFS road. There may also be forest closure orders that prohibit shooting at specific locations. Many recreational users would continue to hear recreational shooting activities, and these would impact their ability to find quiet recreation settings. There are often reports of recreational shooting interfering with people's desired recreation experience, but there are no data to support that this is a frequent occurrence except anecdotal information. It is unclear how frequently this user conflict occurs on a given weekend on the forest.

Recreationists desiring more "quiet" recreation opportunities would be able to utilize the ROS map and motor vehicle use map to locate places with potential for fewer motorized activities and fewer places where recreational shooting would be likely to occur. Such locations may require users to hike, horseback ride or bike ride greater distances to have fewer encounters with other people. There would be no change in the amount of designated wilderness where non-motorized and non-mechanized opportunities would be available.

There is some relevant direction on dispersed recreation in regard to winter recreation. Direction to evaluate cross-country ski and snowplay areas on the forest (1987 Plan, page 57) was followed, but the demand for these activities is still very high and the forest would continue to evaluate and plan for these activities. This would help to meet demand for these activities and to relieve traffic pressure on U.S. Highway180, where most winter recreation facilities are located, but does not recognize the lack of funding for capital improvements. Snowplay activities along throughout northern Arizona continue to increase and often result in health and safety concerns due to indiscriminate parking and snow play. Highway 87 is one such area where snowplay activities continue to increase, causing safety concerns due to lack of safe parking areas. This alternative provides for cooperation between Coconino County and Arizona Department of Transportation to provide safe parking and pursuing this would help to eliminate unsafe parking adjacent to or on Highway 87 (1987 Plan, page 204). Alternative A does not consider adjacent non-forest land planning or opportunities provided that may also relieve winter recreation pressure. Campfire (1987 Plan, page 108-2) and overnight camping restrictions (1987 Plan, page 108, 108-2, 119, 206-110, 206-115) would continue to limit activities like cross-country skiing and snowplay, where compaction of shallow snow and disturbance to other visitors would negatively impact vegetation, soils, and the recreation setting. Under the 1987 plan, there is little direction to provide a winter recreation emphasis to areas across the forest.

Alternative A contains no explicit recreation and transportation suitability determinations. Because there are no suitability determinations, alternative A would not restrict motorized use in botanical or geological areas. Motorized use may still be controlled in these areas, but such decisions would be made individually and without any broader context. This would result in inconsistent management of motorized uses in botanical or geologic areas; some areas could be left without restrictions on motorized use, which would

result in resource impacts such as damage to vegetation or soils. Similarly, alternative A also provides no specific direction regarding mechanized use in these areas; impacts from mountain bike use would be similar, though perhaps of smaller magnitude, to those from motorized use.

Alternative B (modified)

Even though the plan desired conditions are divided into developed, dispersed recreation, trails and trailheads, and interpretation and education categories, the sections provide direction to consider each resource as part of a larger landscape and recreation experience. The desired conditions for developed sites state that trails should link these sites to a variety of dispersed opportunities (FW-Rec-Dev-DC-6) and all sections discuss how to manage the quality, benefits, and impacts of interpretive and educational materials and kiosks in a variety of settings (FW-InterpEd-DC-1, FW-InterpEd-DC-2, FW-InterpEd-DC-3, FW-InterpEd-DC-4, FW-InterpEd-DC-5). This direction would result in a more holistic approach to the recreation resource and a more gradual and planned mosaic of dispersed to developed settings based on use patterns and resource goals. This strategy would improve the quality of both motorized and non-motorized recreation opportunities, as management would have a more thoughtful and integrated approach when considering potential projects. Improved quality of these recreation opportunities would result in increased visitor satisfaction, which reduces the likelihood that recreation users would disperse to other areas. Focusing recreation use in areas specifically managed for it reduces the impacts of recreation use on natural resources (such as soil compaction or loss of vegetation) in areas that may not have sufficient recreation facilities or development.

Areas on the forest that are allocated for higher encounter levels may see disproportionate increases in use as a result. A recent example of this is the reduction in overnight camping in Oak Creek Canyon over the last 20 years. As a result, overnight camping has been displaced, to nearby locations such as other riparian areas in Verde Valley, the Lake Mary area and Stoneman Lake/Mormon Lake. Decreased overnight use has not resulted in decreased visitation to Oak Creek Canyon, in fact day use has increased, nor have impacts to riparian areas decreased. Instead overnight use has simply been displaced to other places with no decrease in overnight visitation on the forest. Similar impacts are expected when future measures are taken to decrease user conflict and maintain semi-primitive recreation settings on the forest. There is no expectation of decreased demand for recreation, but management actions in one location may displace use to other locations.

Alternative B contains desired conditions and guidelines that would direct the forest to manage water-based recreation opportunities (FW-Rec-All-DC-9, FW-Rec-Dev-DC-1, FW-Rec-Dev-DC-7, FW-Rec-Dev-DC-8) and riparian areas (FW-Rip-All-DC -5) to protect water quality (FW-Water-DC-6,) and prevent resource impacts such as vegetation damage, soil erosion, and compaction (FW-Rip-All-DC -1). This alternative would prevent unmanaged recreation in the aquatic management zones, and it would not allow for camping in these places under special use permits (FW-SpecUse-DC-8, FW-SpecUse-G-18, FW-SpecUse-G-19, FW-Rec-All-G-2). It would also prevent designation of dispersed camping corridors within these zones (FW-Rec-Disp-G-5). To meet this guideline in some locations, the forest would need to implement management measures, such as closures, that prohibit dispersed camping within the aquatic management zones (FW-Rec-Disp-G-5).[35] The overall effect of this direction would be to reduce the amount of water-based recreation opportunities that have historically been available to the public. This would prove frustrating to visitors, as waterplay is a highly desirable opportunity to escape summer heat, and such opportunities are limited in Arizona. Some visitors may violate closures, which would increase enforcement needs. However, better management of the remaining, open water-based opportunities may result in these sites' ability to accommodate more users, which would offset this reduction to some degree. Successful management of this situation would be dependent on the forest's ability to provide

[35] See "Designated Areas" for more discussion of this direction's effects on wilderness and wild and scenic rivers such as West Clear Creek and Fossil Creek.

quality water-based recreation outside of sensitive riparian zones and to direct users to more-developed opportunities elsewhere (such as Lake Roosevelt).

This alternative would provide a different strategy for managing recreation impacts to riparian resources in the Long Valley MA. It describes desired conditions for managing camping and motorized and non-motorized recreation in a dispersed setting, while reducing user conflicts and resource impacts (MA-LongV-DC-1, MA-LongV-DC-2, MA-LongV-DC-3, MA-LongV-DC-5). The higher elevation of this management area provides climate relief that is attractive to visitors from central and southern Arizona. Maintaining access to water-based recreation in this area is key, because climate modeling predicts that the number of hot days and duration of heat waves are expected to increase through the latter part of the 21st century , which would cause increasing numbers of visitors to seek these opportunities (USDA Forest Service 2010c). Failure to meet this demand would result in users disregarding closures and dispersing to areas that are not specifically managed to provide for recreation while protecting aquatic resources. This would result in increased damage to these resources, such as soil erosion and degradation of water quality. Additionally, this area is also able to provide for recreational vehicles that are larger than can be accommodated in the forest's developed campgrounds, because the northern portion and ridges of Upper Clear Creek are fairly flat and the roads are in good condition. This is beneficial to these users because opportunities for dispersed camping with RVs have been reduced by the implementation of travel management.

The Coconino NF has a number of designated scenic roads. These include Historic Route 66 All-American Road and Red Rock All-American Road (nationally designated scenic byways) and two Arizona scenic roads, San Francisco Peaks and Sedona-Oak Creek Scenic Roads, cross the Coconino NF. There are several major roads (e.g., Forest Highway 3, State Highway 89A, State Highway 87, and U.S. Highway 180) that are not designated scenic byways, but provide scenic driving experiences and experience high levels of recreational use and through traffic. While the roads themselves are managed by State or county agencies, the resources along the road are Forest Service. The modified proposed action emphasizes the provision of appropriate and sustainable developed facilities (SA-ScenicRds-MgtApp) along these routes as opposed to roadside pulloffs because of the increased safety risk to visitors from the adjacent high-speed traffic (FW-Rec-All-DC-7 and FW-Rec-All-MgtApp). Providing adequate parking in these areas would result in increased safety to both drivers and visitors.

Implementation of the Travel Management Rule resulted in a reduction in the areas available for dispersed motorized camping. The Coconino National Forest Motorized Travel Management FEIS recognized the result of this would be a higher concentration of these activities in these corridors (USDA Forest Service 2011e). Alternative B (modified) describes desired conditions in these corridors and identifies conditions that may trigger a change in management or strategy in order to maintain the recreation setting. Changes could include increasing the miles of designated camping corridors, changing broader corridors to discreet spur-road sites, or closing corridors altogether where mitigation measures cannot be effectively implemented. These strategies would vary based on site-specific conditions, though in general, they would promote ecosystem health in areas of high recreation use while providing for dispersed motorized camping opportunities throughout the forest.

Non-motorized trailheads serve the gateways to Coconino NF, and alternative B (modified) provides guidance for determining their design and location. Some of the key design elements, include: trailhead borders, durability, ingress and egress, conflicts with nearby private land, appropriateness of design for the recreation setting, interpretive information, and special considerations for trailheads that are intended to accommodate trailers and year-round recreation. Designing and locating trailheads according to these desired conditions would result in safer, more visually appealing and functional trailheads, which would improve visitor experiences and wayfinding. Including these design considerations would make the

trailheads more intuitive for users and decrease the likelihood of trailheads being expanded by people parking outside of them.

Alternative B (modified) provides greater flexibility than alternative A for managing the diversity of demands for trails on the forest. Trails are currently designed for recreation uses such as horseback riding and hiking. Increasing use by bicycles and alternate forms of recreation has led to increasing user conflict. While all trails on the forest are currently managed for multiple uses, this alternative recognizes that not all trails are well-suited for this strategy and provides a management approach for considering single-use trails where user conflict cannot be mitigated. Allowing individual trails to be designated for single uses would decrease user conflicts and increase the diversity of recreation experiences on the forest. It may also result in a slight increase in trail density where trails between the same locations have alternate routes for certain users.

Because of the lack of motorized trails on the Coconino NF, alternative B (modified) also provides guidance for future motorized trail designations. The desired condition describes a trail system that accommodates the demand for semi-primitive motorized experiences (such as motorized trails as opposed to roads). Due to its consideration of various motorized trail systems, alternative B (modified) better meets the demand for motorized recreation opportunities than alternative A, which only considers roads and the Cinder Hills Off-highway Vehicle Area as motorized recreation resources.

In alternative A, an entire management area (13) would be devoted to the Cinder Hills Off-highway Vehicle Area, but due to the travel management motor vehicle use map, designation as a specific management area is no longer needed to delineate its boundaries. Instead, alternative B (modified) consolidates the desired conditions for this area to provide the same protections. It would provide access to motorized recreation while utilizing clear signage and route delineation to prevent vehicles from impacting adjacent cinder cones. It is recognized that the Cinder Hills Off-highway Vehicle Area is primarily for recreation and that it is unlikely to ever meet desired conditions for vegetation or soil resources. However, this area provides a uniquely valuable recreation experience for motorized recreators.

Non-motorized snowplay is a popular activity on the Coconino NF and it occurs in both developed and dispersed settings. Because of the safety concerns (FW-Rec-Dev-DC-4) associated with this activity (FW-Rec-All-DC-7), alternative B (modified) provides guidelines for the forest to meet industry standards in developed areas and to discourage snowplay along paved roads where proximity to traffic results in increased safety risks (FW-Rec-Dev-G-4, FW-Rec-Disp-G-4). This would result in the closure of some areas to non-motorized snowplay, which would displace some visitors from areas they have typically used for this activity. In turn, the forest would provide access to other areas for this activity. Management approaches encourage development of management plans or strategies that collaboratively address dispersed recreation activities and/or locations to address user needs, visitor safety, and resource protection (FW-Rec-All-Management Approach, FW-Rec-Disp-Management Approach). In some instances other recreation providers may offer snowplay opportunities or the forest would work collaboratively to identify areas that could be plowed to provide safe places to pull off. Provision of well-coordinated information including leave no trace information would also help snowplay enthusiasts make safer choices for their activities and be more responsible about the impacts of their use.

The direction in alternative B (modified) for non-motorized, wildlife-based recreation is less hunting-specific than alternative A and retains wildlife-viewing direction from amendments 12 and 17. The desired conditions emphasize a diverse range of opportunities (FW-Rec-All-DC-8). In some locations, more primitive, quiet hunting opportunities would be retained similarly to alternative A. The language from alternative A related to seasonal closure areas for motorized travel would be carried forward without changes. The Coconino NF would continue to work with the Arizona Game and Fish Department to meet habitat goals and provide the desired hunting opportunities in these areas under alternative B (modified)

(FW-Rec-All-Management Approach). Under this alternative, wildlife viewing areas that are recognized in alternative A would be provided and possibly expanded in coordination with Arizona Game and Fish Department proposals. These desired conditions and management approaches would meet the public desire for quiet and sometimes remote encounters with wildlife. Across the rest of the forest, hunting and fishing opportunities would be highly variable in the number of encounters expected and remoteness depending on the ROS class and the availability of access by roads and motorized big game retrieval per the most current motor vehicle use map. Therefore, this alternative would meet the demand for a wide diversity of recreational visitors seeking wildlife-related experiences.

The management areas in alternative B (modified) better reflect public use patterns and activities than those in alternative A, which are based on physical attributes of the landscape rather than social attributes. Management areas respond to public concern about the need for "quiet" (non-motorized) recreational settings and provide some areas for less-quiet activities, such as off-highway-vehicle use. As a result, these management areas better provide for a diversity of recreation experiences and meet demand for settings that are lacking statewide. Many management areas have desired conditions for locations that provide solitude and more primitive non-motorized recreation opportunities where "quiet" recreation settings would be found. These include San Francisco Peaks MA (MA-Peaks-DC-2), Inner Basin MA (MA-InBsn-DC-6), Painted Desert MA (MA-PntdDsrt-DC-2), Pine Belt MA (MA-PineBelt-DC-5, MA-PineBelt-DC-6, MA-PineBelt-DC-7, MA-PineBelt-DC-8), Flagstaff Neighborwoods MA (MA-FlagN-DC-4), Lake Mary Watersheds MA (MA-LkMry-DC-2, MA-LkMry-DC-4), Red Rock MA (MA-RedRock-DC-6), Volcanic Woodlands MA (MA-VolcanWd-DC-4), and Long Valley MA (MA-LongV-DC-5). A desired condition for more primitive settings does not mean the entire management area would have those characteristics. For example, the Volcanic Woodlands MA (MA-VolcanWd-DC-3) is also the location of the Cinder Hills OHV Area. Similarly, while there are many opportunities for solitude and primitive recreation experiences in the Red Rock MA, it also includes busy recreation sites along Dry Creek Road and Boynton Pass, as well as parking access to Bell Rock.

Alternative B (modified) retains the important recreation emphasis that was raised through public involvement on amendments 12 and 17 for Walnut Canyon, Flagstaff Neighborwoods (Urban-Rural Influence Zone in amendment 17), Ft. Valley-Mount Elden (a modified Mount Elden Management Area from amendment 17), Sedona-Oak Creek, Oak Creek Canyon, House Mountain-Lowlands (Savannah Management Area in amendment 12) and Sedona Neighborwoods. For these management areas, implementation of alternatives A and B (modified) would not differ in terms of recreation opportunities and settings because restrictions on recreation uses, land exchanges, and SMS and ROS settings would be the same.

Alternative B (modified) recognizes the need for a more diverse range of recreation opportunities in the Verde Valley Management Area, where the trail density is much lower than in nearby Sedona. Recreation impacts in this area have been unmanaged and in some places have damaged sensitive semi-desert vegetation. This alternative would promote recreational opportunities of varying development levels and, in some places, without changing the character of the landscape to be discernibly different from recreational opportunities on other public lands. This more organized approach to recreation management in this area would better meet local demand for both motorized and non-motorized recreational opportunities while reducing the negative ecosystem impacts of off-road and off-trail use, such as erosion and vegetation loss.

Except on designated trails, mechanized use would be unsuitable in all botanical and geological areas under alternative B (modified). This would result in most of the nearly 4,000 acres in these areas being unavailable for uses such as mountain biking as steps are taken to manage these areas in accordance with the suitability determination. The Lime Kiln Trail would be available for mechanized use and it is

possible that future trails may be developed where appropriate. Maintaining this use in a way that is compatible with the protection of these botanical and geological resources would require that the trails are well marked and defined so that social trails do not occur. (See the "Wildlife, Fish, and Plants" and "Geological Resources" sections for more information.) When mechanized users are restricted to designated trails in these areas, it could result in their dispersing to other areas. Increasing mechanized activities in areas where these uses are allowed would increase the potential for resource impacts, such as erosion or soil compaction, or increased management activities to mitigate such impacts.

Alternative C

The effects on recreation forestwide would be qualitatively similar to those under alternative B (modified) except that opportunities for non-motorized recreation use would increase or improve on the eight management areas that emphasize reduced human disturbance. This alternative provides the most extensive guidance for suitability determinations than any of the alternatives (see Recreation Suitability section for this alternative). Alternative C would potentially place the most restrictions on uses as project-specific analysis is completed. Recreationists seeking quiet recreation settings would have the most opportunities to find these in alternative C. Motorized use in the recommended wilderness areas and management areas that emphasize reduced human disturbance would cease or be decreased over time as closures and site-specific road obliteration were conducted. No decrease in forestwide visitation would be expected, but fewer back-country non-motorized users would be displaced by motorized users (Stokowski and LaPointe 2000). Motorized dispersed camping would not increase in management areas that emphasize reduced human disturbance. Current acres of motorized dispersed camping would remain the same, but may move to different locations based on response impacts and recreation needs.

Many recreational users near communities and residents of communities and subdivisions continue to hear recreational shooting activities and these would impact their ability to find quiet recreation settings. It is unclear how frequently this user conflict occurs on a given weekend on the forest. There are often reports of recreational shooting interfering with people's desired recreation experience, but there are no data to support that this is a frequent occurrence except anecdotal information. Overall, this would move recreational shooting opportunities away from the highest population and highest use areas for dispersed recreation and increase the sense of security for recreational users and residents in these areas. In some cases, visitors who want recreational shooting opportunities would have to travel farther from their homes to a location where the activity is allowed.

Alternative C would provide the greatest increase in recommended wilderness and addition of seven new management areas that emphasize reduced human disturbance and non-motorized recreation activities. This increase in areas with reduced noise disturbance would result in reduced areas where recreational shooting and motorized recreation could occur.

Future projects in the management areas that emphasize reduced human disturbance would have the potential to make determinations to prohibit recreational shooting. If this were to occur, there would be new locations where recreation users could find quiet recreation settings. In contrast, some areas currently used for recreational shooting could see this activity restricted, forcing recreational shooters to seek locations where this activity is not prohibited. Some users could see this as an inconvenience, but it would not likely result in any significant impact to visitors' ability to participate in this activity.

Under alternative C, three new seasonal closure areas (Cottonwood Basin, Nordic Ski Center, and Woody Ridge) would add approximately 8,783 additional acres to the low-noise-disturbance areas. This would reduce noise from motorized recreation and provide places where there is a seasonal provision of lower disturbance environments for hunting and wildlife over the winter.

Alternative C would provide the same opportunities for snowmobile use initially as alternative B (modified). It has potential for the fewest acres open to snowmobile use over time as project decisions are made that implement suitability determinations.

Similar to alternative B (modified), alternative C would restrict mechanized use in all botanical and geological areas. The effects would be the same as alternative B (modified).

Alternative D

The effects to recreation under alternative D would be qualitatively similar to those under alternative B (modified). Like alternative B (modified), the guidelines in alternative D allow for mechanized recreation on designated trails in botanical and geological areas. Alternative D only sets aside the geological area (185 acres) at Cottonwood Basin and only protects the unique geological resources as opposed to alternatives B (modified) and C, which protect geological and botanical resources (763 acres) at this location. Accordingly, alternative D would determine 578 additional acres to be suitable for mechanized use, compared to alternatives B (modified) and C. There would be an increased potential for resource impacts, such as erosion or soil compaction, or increased management activities to mitigate such impacts on these acres.

Trails

Affected Environment

According to the Coconino NF's corporate database (Natural Resource Management), there are approximately 750 miles of trails that are managed by the Forest Service. The large majority of these trails are open to all modes of non-motorized recreation. There are currently few motorized trail systems, although a number are planned. Each trail is assigned a use that determines which trail design standards would be applied to it. For instance, a trail designed for hiking may be useable for both bicycles and equestrians, but its use designation tells the Forest Service trail crew what type and level of maintenance applies to the trail. Figure 6 shows the distribution of trails across the forest in both the use they are designed for and the condition class they have been designed. Trail condition class 1 (TC1) is the most primitive class and requires wayfinding skills to navigate and TC5 is the most developed class and is typically paved or surfaced in some manner. As figure 6 shows, most of the trails on the forest are designed for hiking and pack and saddle uses and are in TC3 or lower. These types of trails are consistent with the roaded natural and more primitive settings on the ROS (USDA Forest Service 1990).

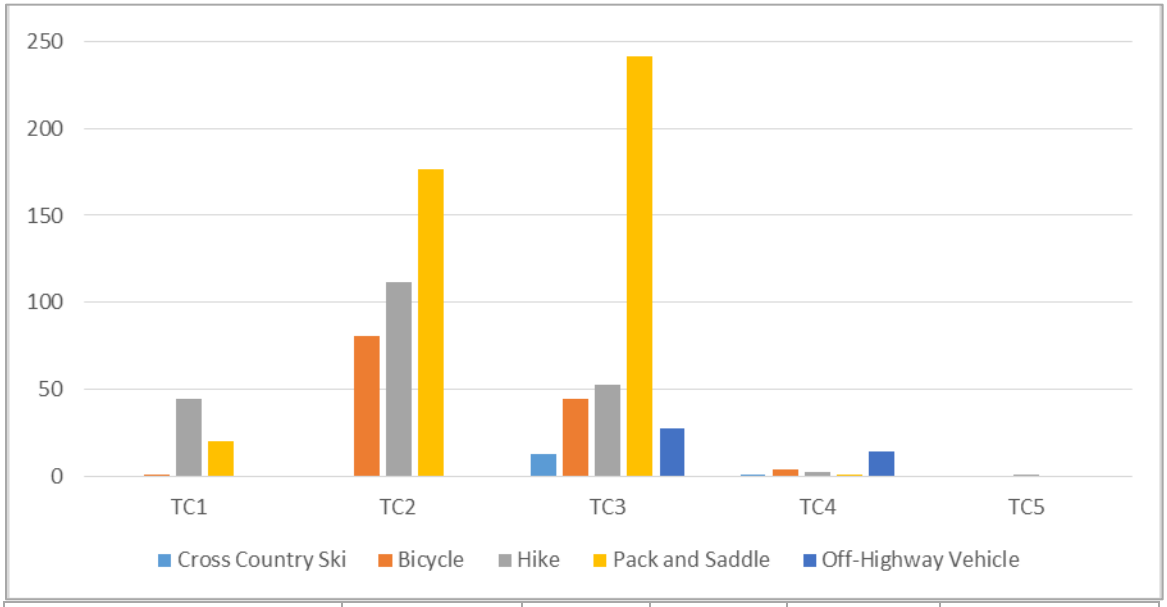
Even though figure 6 shows only 14 miles of cross-country ski trail, there are hundreds of trails designed for other recreation types that are managed for year-round recreation and allow for cross-country skiing and snowshoeing.

Bicycling is a recreation use that has increased in popularity since the 1987 plan was instated (USDA Forest Service 2008a). According to the National Survey of Recreation and Environment in 2000, an additional 28 million respondents said they had participated in bicycling as a recreational activity since the 1995 survey (USDA Forest Service 2002a). Sedona and Flagstaff are nationally known mountain biking destinations. As the sport evolves and more advanced mountain bikers seek trails with more technical challenge, demand has increased for more trails designed to mountain biking trail standards that are more primitive.

Many trails on the Coconino NF have been designed for horse, pack, and stock use, but they are often used by other types of recreation and, if not maintained, may be incompatible with equestrians' desired trail standard and, therefore, recreation experience. The longest trail available for horse, pack, and stock use is the Arizona Trail, which connects the Tonto, Coconino, and Kaibab National Forests. There were

comments received during scoping on the desire for a second long-distance trail connecting the Verde Valley and Coconino NF above the Mogollon Rim.

There are only 14.2 miles of designated motorized trails on the forest. On the other hand, the Coconino National Forest Motor Vehicle Use Map designates the miles of roads for off-road vehicle use per direction in the Coconino National Forest Travel Management Decision (USDA Forest Service 2011g). Using the 2014 motor vehicle use map for this analysis (USDA Forest Service 2014a), 2,775 miles have been designated. Trails and roads typically provide different recreation experiences because they are maintained and designed differently and have different vegetation clearance requirements.



TRAIL CLASS	CROSS-COUNTRY SKI	BICYCLE	HIKE	PACK AND SADDLE	OFF-HIGHWAY VEHICLE
TC1 -Minimally Developed	0	0.5	44.0	19.8	0
TC2 -Moderately Developed	0	80.2	111.2	176.3	0
TC3- Developed	12.6	44.4	52.4	241.9	27.0
TC4 -Highly Developed	0.9	3.7	1.9	1.0	13.7
TC5 -Fully Developed	0	0	0.7	0	0
Subtotals	13.5	128.8	210.2	439.0	40.7

Figure 6. Miles of trail by condition class and trail use design (USDA Forest Service 2017b)

Environmental Consequences

Alternative A

The current plan contains a desired condition to "maintain a variety of forest trails including foot, horse, bicycle and motorized trails, as well as opportunities for trails that are accessible for people of all abilities and to evaluate the need for additional trails (1987 Plan, page 22). It also provides guidance about trail maintenance (1987 Plan, pages 59, 65-12, 75, 81, 89 to 90, 99 to 102, 108-2, 108-3 to 4, 110, 115-4, 119, 138, 140, 167, 186 to 187, 187-1 to 187-2, 197 to 198, 200 to 202, 206-1, 206-3, 206-10, 206-12, 206-15 to 17, 206-22 to 27, 206-32, 206-34, 206-37, 206-39 to 40, 206-41, 206-44 to 46, 206-48, 206-52, 206-57, 206-62, 206-65, 206-67 to 206-69, 206-73 to 206-74, 206-79 to 206-80, 84-85, 206-87 to 206-90, 206-92 to 206-93, 206-95, 206-98, 206-100, 206-104 to 206-105, 206-108 to 206-110, 206-114 to 206-116). Plan language prohibits horse and pack stock use on some trails (1987 Plan, page 90). Alternative A does not

address the need to provide for different skill levels. This desire would be considered in trail planning, but there is no requirement that trails provide for different skill levels.

The schedule of activities for trails (is also outdated and, as a result, would lead to some conflicts with current law, regulation, and policy, in addition to not directing the forest to respond appropriately to changing recreation demand) (1987 Forest Plan new page 242-21 to 23). The popularity of hiking and mountain biking especially in Red Rock country and the Mount Elden-Dry Lake Hills has led to user conflicts, high levels of use on some trails that is uncharacteristic for the ROS class, concerns about trail densities, and trail tread damage. This alternative provides little specific guidance that would help to alleviate any of these concerns; continuing implementation would lead to degraded recreation settings, negative impacts to vegetation and soils, and decreased user satisfaction.

The provision of new motorized and non-motorized trails would not be included in the schedule of activities. Evaluations could be made to determine the need for new trails; however, there would be no requirement to balance the number of available trails across the forest. This would result in the areas of forest that border larger communities, such as Sedona or Flagstaff, having many trails, while more remote communities, such as those in the Verde Valley, would have few to none. It would also provide fewer opportunities for such communities to grow the recreation-based sectors of their economies, as the forest would not possess the infrastructure to support them. This disparity would result in frustration to residents of those communities, who consider this difference unfair and perceive favoritism toward larger communities.

Alternative A would allow only for a narrow provision of connectivity with trails managed under other jurisdictions. It specifies that State, County and community parks departments to connect forest trails with parks and green-belt corridors (1987 Plan, page 90). The potential for other partners such as other Federal agencies, large landowners, and tribes to work collaboratively to provide trail connectivity would not be supported with the specific language of the standards and guidelines.

Alternative B (modified)

This alternative emphasizes a higher level of development for trailheads along busy highways. Increased development of trailhead facilities reduces the safety risks to trail users in close proximity to traffic. Alternative B (modified) describes a desired condition that trails should link developed recreation sites to a variety of dispersed opportunities (FW-Rec-Dev-DC-6). This direction would result in a more holistic approach to recreation management and would create a mosaic of dispersed to developed settings that blend into one another. This strategy would improve visitor access between these kinds of opportunities, as management would have a more thoughtful and integrated approach when considering potential projects. This would, in turn, result in increased visitor satisfaction, which reduces the likelihood that recreation users would disperse to other areas. Focusing recreation use in areas specifically managed for it reduces the impacts of recreation use on natural resources (such as soil compaction or loss of vegetation) in areas that may not have sufficient recreation facilities or development.

Trailheads are the gateways to the Coconino NF, just as trails are routes for exploration of the forest, and alternative B (modified) provides guidance for determining their design and location. Some of the key design elements that alternative B (modified) addresses, on which alternative A is silent, are trailhead connections especially to trail systems on neighboring lands (FW-Rec-Trails-DC-1, FW-Rec-Trails-DC-11) and decreased conflicts with nearby private land (FW-Rec-Trails-G-1, FW-Rec-Trails-G-6, FW-Rec-Trails-O-1), trailhead durability (FW-Rec-Trails-DC-4), ingress and egress (FW-Rec-Trails-DC-10), appropriateness of design for the recreation setting (FW-Rec-Trails-DC-3), interpretive information (FW-InterpEd-DC-1, FW-InterpEd-DC-2, FW-InterpEd-DC-3, FW-InterpEd-G-3), and special considerations for trailheads that are intended to accommodate trailers (FW-Rec-Trails-DC-3), and year-round recreation (FW-Rec-Trails-G-2). Designing and locating trailheads according to these desired conditions would

result in safer, more visually appealing and functional trailheads, which would improve visitor experiences and wayfinding. Including these design considerations would make the trailheads more intuitive for users and decrease the likelihood of trailheads being expanded by people parking outside of them.

Alternative B (modified) is more adaptable in managing the diversity of demands for trails on the forest. Trails are currently designed for traditional non-motorized recreation uses such as horseback riding and hiking, and increasing use by more technologically sophisticated bicycles has led to increasing user conflict. While most trails on the forest are currently managed for multiple uses (FW-Rec-Trails-DC-5), the modified proposed action recognizes that not all trails are well-suited for this strategy and, consequently, has a management approach to consider single-use or similar-use trails where user conflict cannot be mitigated (FW-Rec-Trails-Management Approach). As such, alternative B (modified) is more adaptable than alternative A in that it embraces both strategies (multiple- and single-use trails) (FW-Rec-Trails-DC-3) and relegates the designation of each trail type to a project-level, site-specific decision. It also has desired conditions that address the impacts of social trails in sensitive ecosystems and considers which social trails would be prioritized for rehabilitation or closure due to these impacts (FW-Rec-Trails-DC-11, FW-Rec-Trails-DC-4). This would decrease user conflict on high-use trails and increase the diversity of recreation experiences on the forest. It may also result in a slight increase in trail density where trails between the same locations have alternate routes for certain users.

Alternative B (modified) provides guidance about the level of development at trails, trail types and settings (FW-Rec-Trails-DC-1, FW-Rec-Trails-DC-2, FW-Rec-Trails-DC-3). It contains an objective to develop or modify 2 to 8 systems of bike, equestrian, and/or motorized trails within 10 years of plan approval (FW-Rec-Trails-O-1). While some single-use trail types are noted, some trails would be open to multiple uses. While most forest trails are currently managed for multiple uses, increasing use by bicycles and motorized trail uses has led to increasing user conflict. This alternative provides a management approach for considering single-use trails where they may prove the best method of mitigating user conflict. Allowing specific trails to be designated for single uses would decrease user conflicts and increase the diversity of recreation experiences available on the forest. It may also result in a slight increase in trail density where trails between the same locations have alternate routes for certain users.

This alternative also describes management approaches for collaboration with stakeholders when planning trails, expansion of volunteer opportunities and partnerships, and the potential for use of shared trailheads. This approach would help ensure that various stakeholder communities are included as new trails are developed (FW-Rec-Trails-Management Approach). This inclusion would improve the relationship between the forest and its users and ensure greater public input in new trails, which can ensure greater public support for any new trail. Greater inclusion of the public also results in increased user satisfaction with our actions and projects, which increases the likelihood of visitors' using the facilities provided rather than recreating outside them. This, in turn, reduces recreation-related impacts to natural resources, such as vegetation removal, soil loss, and hardening of wider areas around trailheads and other sites.

There is a management approach that urges managers to collaborate with other trail providers to encourage an integrated approach across ownership jurisdictions and to avoid duplication of opportunities (FW-Rec-Trails-Management Approach). There are also opportunities to connect to trail systems provided by other entities that increase the opportunities and convenience for trail users (FW-Rec-Trails-DC-1). For example, specialized trail opportunities such as the Coconino County mountain bike skills park may be better accommodated on non-forest land, but could connect to trails on the forest. This plan language allows for much more flexibility in developing trail connectivity than would that in alternative A, which would better serve trail users by providing a more integrated system of opportunities. Better meeting

visitor needs increases their satisfaction, which reduces the likelihood that they would disperse to other areas where they may cause impacts to natural resources, such as vegetation loss from trampling and soil erosion.

Alternative B (modified) encourages use of partners and volunteers to assist in trail planning, construction, and stewardship (FW-Rec-Trails-Management Approach). This would expand the capacity of the forest to offer quality trail experiences, would increase community support for their locations and upkeep (FW-Rec-Trails-Management Approach.), and may help to reduce user conflicts (FW-Rec-Trails-G-6). Again, increasing visitor satisfaction with their recreation experiences reduces the likelihood that they would disperse to other areas where they may cause impacts to natural resources.

Alternative B (modified) would protect aquatic and riparian resources by confining recreation impacts (FW-Rec-Disp-DC-3, FW-Rec-All-DC-6) to specific access points, such as trail crossings. Many popular swimming holes, springs, and boating areas have extensive shoreline vegetation loss due to off-trail travel and user-created access points. Alternative B (modified) includes desired conditions that would result in increased signage and trail markings in these areas to increase the visibility of trails and discourage off-trail travel (FW-Rec-Trails-DC-3, FW-Rec-Trails-DC-4, FW-Rec-Trails-DC-11). This would not limit recreation use or access, but would simply confine it to managed trails and access points. Allowing shoreline vegetation to regrow would increase the visual quality of these sites, which would improve the quality of recreation users' experience. This alternative also provides for the use of management actions such as closures where recreation impacts are causing resource degradation in any ROS setting. Such actions would reduce access to water-based recreation opportunities for the duration of the closures; this would increase use at the remaining open sites, which could increase impacts to soils and vegetation in those shoreline areas.

The desired conditions for trails also describe the types of recreation opportunities and impacts that may come from motorized and mountain bike trails (FW-Rec-Trails-DC-2, FW-Rec-Trails-DC-3, FW-Rec-Trails-DC-4), which alternative A addresses in a more limited fashion. A key strategy to addressing the lack of diversity in trail settings and design is to develop trail systems that address the lowest-supply trail type: motorized (FW-Rec-Trails-DC-2). There is also demand for long-distance trails for motorized (FW-Rec-Trails-DC-7, FW-Rec-Trails-DC-8) and equestrian use (FW-Rec-Trails-DC-2). The current system provided on the Coconino NF would not meet these expectations or provide adequate motorized opportunities to the average motorized users. Alternative B (modified) contains an objective to develop 2 to 8 trail systems for bicycle, motorized, and equestrian use over the next 5 to 10 years (FW-Rec-Trails-O-1). There is a guideline to address the resource issues associated with motorized recreation and mountain biking (FW-Rec-Trails-G-3), such as increased vegetation loss, soil erosion, and soil compaction. This alternative also contains direction toward managing the desired recreational experiences of these users (FW-Rec-Trails-DC-3, FW-Rec-Trails-DC-4, FW-Rec-Trails-G-1). Increased quality of experience would result in decreased likelihood of users dispersing to other areas that may not be managed for recreation impacts such as vegetation and soil loss.

Alternative B (modified) provides guidance on the desired outcome of future motorized trail designations, to address the lack of motorized trails currently on the forest. The desired condition would influence future trail planning to create a system of trails that can accommodate multiple vehicle types, with some trails designated only for single-track use. This would allow for a different experiences than a system providing only trails that allowed all motorized uses (FW-Rec-Trails-DC-6, FW-Rec-Trails-DC-7, FW-Rec-Trails-DC-8, FW-Rec-Trails-DC-9). This alternative provides for greater or more diverse motorized recreation opportunities than alternative A. Better meeting visitor needs on managed trails reduces the likelihood that they would seek motorized recreation opportunities in areas not managed for these uses. This, in turn, would reduce the impacts to soils and vegetation, as described above.

Alternative B (modified) provides desired conditions that support the rehabilitation of unauthorized trails, which would eliminate confusion over which trails are open to motorized use (FW-Rec-Trails-DC-4, FW-Rec-Trails-DC-6). It also encourages signing and education (FW-InterpEd-DC-5) to reduce unintentional off-road travel (FW-InterpEd-DC-2, FW-InterpEd-DC-3). These measures would reduce the impacts of motorized use, such as disturbance to wildlife, vegetation loss, and soil erosion). Expanded information would also provide users with disabilities a means to determine which trails would best suit their individual needs and desires for trails experiences (FW-InterpEd-DC-1). This would increase the quality of their recreation experience.

Alternative B (modified) consolidates the desired conditions for the Cinder Hills Off-highway Vehicle Area and provides for clear signing (FW-InterpEd-DC-3, FW-InterpEd-DC-5) and delineation (FW-Rec-Trails-DC-6, FW-Rec-Trails-DC-4). This would prevent vehicles from impacting adjacent cinder cones, while at the same time providing access to motorized routes that can extend the recreation experience (FW-Rec-Trails-DC-8). It is recognized that the Cinder Hills Off-highway Vehicle Area is primarily for recreation and it is unlikely to meet desired conditions for vegetation or soil resources under that management. However, this area provides a uniquely valuable recreation experience for off-highway-vehicle users.

Language on coordination with the communities of Flagstaff and Sedona in alternative A (Amendments 12 and 17) has been broadened in alternative B (modified) to apply forestwide (FW-Rec-All-Management Approach). For example, where amendment 17 language required coordination with the Flagstaff Urban Trail System, alternative B (modified) has a forestwide desired condition to increase trail connectivity (FW-Rec-Trails-DC-1). A forestwide management approach encourages coordination with any non-Forest Service trail system (FW-Rec-Trails-Management Approach). The result of this broadening of a coordinated management strategy is a more consistent consideration of community needs and would result in a more functional and integrated system of trails. This would result in improvements to the quality of life for a larger number of communities, positive partnerships with communities, and greater support for management actions and decisions.

Alternative B (modified) includes a desired condition that recognizes the need for a more diverse range of recreation opportunities in the Verde Valley Management Area (MA-VerdeV-DC-3) where the trail density is much lower than in the nearby Sedona area. Recreation impacts in the area have been unmanaged and in some places have damaged sensitive semi-desert vegetation. The plan would promote recreational opportunities of different development levels and, in some places, without changing the character of the land to be discernibly different from recreational opportunities on other public lands (MA-VerdeV-Management Approaches). The more organized approach to recreation management in this management area would result in less off-trail and off-road recreation that disturbs the delicate arid ecosystems and better meets local demand for recreational opportunities.

Alternative B (modified) addresses the Coconino NF's niche as a destination for recreation based on historic trails and sites. Visiting historic sites is one of the top five uses on the forest and providing these experiences requires preservation and adaptive reuse of historic trails. The desired condition in alternative B (modified) is to preserve these resources, but allow for their continued visitation (FW-Hrtg-DC-7, FW-Hrtg-DC-10, FW-InterpEd-DC-8). As a result, historic trail use by visitors would be expanded where it can also meet the objectives of preserving the historic resource.

Geological and botanical areas have been established to protect and maintain unique characteristics and prevent negative impacts from human activities. Within the Cottonwood Basin Geological and Botanical Area, a guideline restricts access to foot traffic (SA-RNABotGeo-G-7). Mountain bikers and motorized users would be restricted from using the 763 acres of this special area. In the remaining geological and botanical areas, mountain biking, horseback riding, and hiking would continue on appropriate, established

trails unless there are negative impacts from these activities (such as vegetation and soil loss associated with trampling or compaction). To assure the unique characteristics are maintained, site-specific analysis and actions, site closures or other management actions would be taken as needed (SA-RNABotGeo-DC-1, SA-RNABotGeo-G-1).

Alternative C

Under alternative C, the effects to trails are the same as under alternative B (modified).

Alternative D

Under alternative D, the effects to trails are the same as under alternative B (modified).

Recreation Suitability

Affected Environment

According to the 1982 Planning Rule Provisions, suitability is "The appropriateness of applying certain resource management practices to a particular area of land, as determined by an analysis of the economic and environmental consequences and the alternative uses foregone." There are no explicit suitability determinations for recreation or transportation in the 1987 plan, including on where snowmobiling and recreational shooting can occur on the forest. Some restrictions on these uses may be implied based on the ROS classification and whether or not the character of the area should be "remote" or non-motorized. However, the 1986 ROS Guide does allow for over-snow motorized use even in areas of SPNM.

Environmental Consequences

Alternative A

As mentioned previously, the 1987 plan contains no explicit recreation or transportation suitability determinations, therefore, motorized recreation on roads and trails and snowmobile use would continue across the forest outside of wilderness, the locations restricted by 1987 plan standards on the off-highway vehicle map, forest closure orders, and travel management decisions. Currently, about 1.7 million acres of the forest is accessible within 1 mile of a road. Just because an area is suitable for a particular use does not mean that a road, trail, or area would be constructed or authorized in the future. Those decisions are made at the site-specific level. Also the presence of an existing road in an area that is not suitable for that use does not automatically mean that the road is out of compliance with the forest plan. There may be cases where the road remaining open is essential for safety and access, such as a road to a private inholding.[36] Without suitability guidance in the 1987 plan, non-motorized recreation settings and areas of low density roads would become rarer as the forest responds to increased demand for motorized recreation. This would result in reduced opportunities for recreation users to have quiet, non-motorized experiences.

Recreational shooting (not to be confused with hunting, which involves the use of firearms while legally pursuing wildlife during an open hunting season) is not restricted in the 1987 plan. However, there are restrictions in the Code of Federal Regulations (CFR) that include lands managed by the forest. 36 CFR 261.10(d)(1) restricts shooting 150 yards from a residence, building, campsite, developed recreation site or occupied area. In addition 36 CFR 261.10(d)(2) restricts shooting across or on a National Forest System (NFS) road or body of water adjacent to a NFS road. There may be forest closure orders that prohibit shooting at specific locations. Considering these existing restrictions, recreational shooting is currently restricted on approximately 216,037 acres (11 percent) of the forest. Many recreational users near communities and residents of communities and subdivisions continue to hear recreational shooting activities and these would impact their ability to find quiet recreation settings. It is unclear how frequently

[36] An inholding is a parcel of private property surrounded by national forest.

this user conflict occurs on a given weekend on the forest. There are often reports of recreational shooting interfering with people's desired recreation experience, but there is no data to support that this is a frequent occurrence except anecdotal information.

Table 47 compares the acres of the forest that are suitable or not suitable for a given recreation use by alternative. For further comparison of alternatives, see the recreation suitability subheading under alternatives B (modified), C, and D.

Alternative B (modified)

Under alternative B (modified), ROS is one factor in determining recreation and transportation suitability. The uses considered in recreation and transportation suitability include: new motorized areas, NFS roads, and motorized trails more than 50 inches wide (public access), NFS motorized trails less than 50 inches wide, temporary roads for administrative access, permanent roads for administrative access, mechanized and non-motorized travel. All of these uses are suitable in urban, rural, and roaded natural ROS settings representing over 85 percent of the forest. See table 14 in chapter 4 of the revised plan, Suitable Uses, Recreation and Transportation Suitability.

In semi-primitive motorized settings, new motorized areas are not suitable. In semi-primitive non-motorized, new motorized areas, NFS roads, and motorized trails more than 50 inches wide (public access), NFS motorized trails less than 50 inches wide (including single track trails) and permanent roads for administrative access are not suitable. In primitive ROS, only mechanized travel is suitable, while in wilderness WOS settings, neither mechanized nor motorized uses are suitable. These restrictions would maintain the recreation setting provided by the ROS and would result in more consistent management of recreation settings for motorized travel and vegetation management projects.

Special areas would also not be suitable for some of these uses based on their management needs. Research natural areas, botanical and geological areas, and wilderness are all only suitable for non-motorized travel. Recommended wilderness may also have mechanized recreation in addition to non-motorized recreation up until the time it is designated by Congress. For eligible and recommended wild and scenic rivers, only wild segments are not suitable for motorized trails and roads and the others are suitable, but the Wild and Scenic River Act limits where they can occur and for what purposes. Restrictions on wilderness and wild and scenic rivers are the same for alternative A, even though the restrictions in alternative A are not explicitly called suitability.

Table 47. Recreation suitability acreages by alternative

Recreation Suitability		Total Acres			Percent of Forest		
		Alt. B Modified	Alt. C	Alt. D	Alt. B (Modified)	Alt. C	Alt. D
New Motorized Areas	Suitable	713,842	620,692	712,810	39	34	39
	Not Suitable	1,129,123	1,222,273	1,130,155	61	66	61
Temporary Roads	Suitable	1,665,046	1,585,113	1,681,450	90	86	91
	Not Suitable	177,919	257,852	161,515	10	14	9
Permanent Roads	Suitable	1,465,920	1,109,467	1,469,290	80	60	80
	Not Suitable	377,045	733,498	373,675	20	40	20
Motorized Trails	Suitable	1,466,038	1,109,467	1,469,290	80	60	80
	Not Suitable	376,927	733,498	373,675	20	40	20
Mechanized Travel	Suitable	1,681,080	1,681,198	1,681,776	91	91	91
	Not Suitable	161,885	161,767	161,189	9	9	9

Recreation Suitability		Total Acres			Percent of Forest		
		Alt. B Modified	Alt. C	Alt. D	Alt. B (Modified)	Alt. C	Alt. D
Non-motorized Travel	Suitable	1,842,965	1,842,965	1,842,965	100	100	100
	Not Suitable	0	0	0	0	0	0
Recreational Shooting	Suitable	N/A	1,134,333	N/A	N/A	62	N/A
	Not Suitable	N/A	492,595	N/A	N/A	27	N/A
	Existing Restrictions	216,037	216,037	216,037	11	11	11
Snowmobile Use	Suitable	N/A	1,142,717	N/A	N/A	62	N/A
	Not Suitable	N/A	135,238	N/A	N/A	7	N/A
	Existing Prohibitions	565,010	565,010	565,010	31	31	31

Under this alternative, approximately 80 percent of the forest would be considered suitable for motorized recreation and/or transportation. If the forest were to develop roads or motorized trails on all these acres, the ability of visitors to find opportunities for non-motorized and quiet recreation would be significantly reduced. It is unlikely that the forest would do this, but under this alternative it is possible. Conversely, 100 percent of the forest is identified as suitable for non-motorized uses under this alternative. If forest managers chose to maximize the land available for non-motorized uses, visitors seeking motorized recreation would see their opportunities significantly reduced. In botanical and geological areas, alternative B (modified) directs that mechanized use (such as mountain biking) would not be suitable except on designated routes. This would result in most of the approximately 700 acres in these areas being unavailable for uses such as mountain biking, as steps are taken to manage these areas in accordance with the suitability determination. This represents a small restriction to these uses and would not result in a measureable change in the recreational opportunities that are available to the public. It could result in the construction of one or two bicycle trails and would allow the continued mechanized use of the Lime Kiln Trail within the Verde Valley Botanical Area, but it is also possible that no new trails would be constructed.

Like alternative A, there are no suitability determinations for where snowmobiling and recreational shooting could occur on the forest in alternative B (modified), but other restrictions do apply (see table 46). Accordingly, the effects associated with these activities are similar to alternative A.

Alternative C

This is the only alternative that includes guidance about the suitability of recreational shooting and snowmobile use.

In alternative C, designated and recommended research natural areas, botanical areas, geological areas, wildlife habitat management areas, Walnut Canyon Management Area, Sedona/Oak Creek Management Area, and Long Valley Management Area would not be suitable for recreational shooting. Recreational shooting does not include the use of firearms while legally pursuing wildlife during an open hunting season. In addition to the approximately 216,037 acres (11 percent) of the forest where there are currently restrictions on recreational shooting, this alternative would identify an additional 492,595 acres (27 percent) as not suitable for that activity. The plan also acknowledges that some portions of the Flagstaff Neighborwoods would not be suitable for recreational shooting, but leaves the decisions on where to locate the site-specific closure orders. Overall, this would move recreational shooting opportunities away from the highest population and highest use areas for dispersed recreation and increase the sense of security for recreational users and residents in these areas. In some cases, visitors

who want recreational shooting opportunities would have to travel farther from their homes to a location where the activity is allowed.

Because of the increase in recommended wilderness and the delineation of wildlife habitat management areas in alternative C, there would be an increase in acres considered not suitable for new motorized areas, motorized trails, and roads for public access. As a result of these differences, the amount of the forest suitable for these activities would decrease by 5 percent for new motorized areas, 20 percent for new motorized trails, and 20 percent for new public access roads compared to alternative B (modified). This would result in a slight decrease in the amount of area available for motorized recreation, but it is small enough that shifting these users to other areas would not likely result in any noticeable increases in use in those areas.

In alternative C, primitive and semi-primitive non-motorized areas, and Walnut Canyon Management Area would be not suitable for snowmobile use. This would lead to snowmobile use being restricted from recommended wilderness and most special areas. In total, it would restrict snowmobile use, except for authorized use to access private property, on approximately 7 percent (135,238 acres) of the Coconino NF. Combined with the existing prohibitions to snowmobile use (565,010 acres), snowmobile use would be restricted on approximately 38 percent (700, 248 acres) of the Coconino NF. This would increase opportunities for quiet winter recreation for cross-country skiing and snowshoeing.

Alternative D

The effects for alternative D's suitability would be essentially the same as for alternative B (modified).

Recreation Special Uses

Affected Environment

Recreation special-use permits authorize the use and occupancy of NFS lands for activities and services that are provided to the public in exchange for a fee. Permits are authorized when the proposed activities support the Forest Service mission, meet demonstrated public needs, and are consistent with the desired conditions for the use area. While at their most basic level, permits are merely a mechanism for granting permission to use NFS lands, when they are used to enhance the agency's mission, they become a partnership between the forest and the permittees.

Special uses are divided into two categories: recreation and lands. Recreation special uses include uses such as: resorts, ski areas, outfitter-guides, and recreation events. Most of the direction for managing special uses is specified in the Forest Service directives (FSH and FSM). In 2016, the Coconino NF had approximately 320 recreation special use permits. At least one-third of these are outfitter-guide permits. The majority of the remaining permits are for recreation residences, recreation events, and non-commercial group uses.

The demand for outfitter-guide permits in the Sedona and Flagstaff areas is very high. Within the amendment 12 area of Sedona, new permits are issued only through a prospectus. The Flagstaff Ranger District has had a moratorium on new permits, pending the completion of a needs assessment and capacity analysis. Demand for outfitter-guide permits on the Mogollon Rim is primarily limited to hunting. As the highly desired area around Sedona reaches capacity, permittees and recreation managers are looking to the other districts for potential tourism opportunities.

Environmental Consequences

Alternative A

The 1987 Forest Plan contains very little forestwide direction for recreation special uses. Many of the standards and guidelines are procedural in nature and do not directly affect resources on the ground. Direction that does apply to these activities is found instead within the standards and guidelines for recreation, and also where the plan has been amended to reduce the impacts of commercial uses on wildlife, scenery, and recreation settings (Amendments 12 and 17). The lack of forestwide guidance results in permits being issued and managed inconsistently across the forest, with little strategic direction. This results in confusion to the public, who do not understand why they may be able to obtain a permit on one district but not another, or why the process for getting one varies so greatly.

The provisions in amendments 12 and 17 provide specific guidance for the management of recreation special uses in the Sedona and Flagstaff areas, respectively. Under amendment 12, large group events are limited to suitable developed sites (1987 Plan, page 206-26), but there is no objective to identify and designate such sites. This makes it difficult for the forest to authorize events that require staging areas or larger spaces. Another guideline is that commercial tours blend visually into the landscape and do not draw attention to the activity (1987 Plan, page 206-15), This requires that equipment associated with these activities be painted colors and patterns that do not detract from the visual quality of the landscape for other users. Amendment 12 also addressed tours at a popular cultural site and stated that any commercial use must be consistent with site protection and visitor experience objectives (1987 Plan, 206-45. This guideline would limit the number and types of tours permitted at this site and preserve the overall recreation experience.

Alternative A includes an objective from amendment 12 that directs the forest to work with climbing and air tour companies during breeding seasons to eliminate disturbances near occupied eyries and raptors' nests on cliff faces (1987 Plan, page 206-11). This coordination would protect wildlife resources associated with cliffs. There are also plan components on aircraft activities related to commercial filming to protect threated, endangered, and sensitive species (1987 Plan, page 206-11 and 206-28). This standard and guideline would reduce the impacts associated with noise and other disturbances from these activities during breeding seasons and within sensitive habitats. Amendment 12 also prohibited aircraft landing within the area except for emergencies, management needs, and hot air balloon companies (1987 Plan, pages 206-24 and 206-27), which would all need to mitigate their impacts but would not be prohibited. Beauty and natural quiet are promoted through reducing the amount of aircraft, landings, and encounters within the Sedona area. Wildlife species would also benefit from the reduced disturbance.

Amendment 17 prohibits additional outfitter-guide and group activities in certain locations (1987 Plan, pages 173, 206-65, 206-88, 206-100, 206-105, and 206-110). Restricting these locations would decrease the impacts of these activities on wildlife and cultural resources and would decrease user conflict. Amendment 17 also restricts large group events from riparian and open water areas, ponderosa pine, and mixed conifer on greater than 40 percent slope and the interior of mountain meadows outside of developed areas (1987 Plan, page 206-66). This restriction on open water and riparian areas for large group events would prevent the permitting of fishing and boating events in the area but, on the other hand, would prevent impacts to riparian vegetation from trampling and disturbance of shoreline and wetland birds. Interior mountain meadows (montane grasslands in the ERU mapping) would also be protected from trampling and soil compaction impacts from large group events. Amendment 17 also directs the forest to coordinate outfitter-guide activities with nearby national monuments (1987 Plan, pages 206-65206-88, 206-92, and 206-110). This direction would require the forest to coordinate but would not necessarily limit the forest's ability to issue permits in nearby areas. As a result, activities may occur

under special use permits that influence recreation experiences associated with social encounters for national monument visitors.

The provisions in alternatives 12 and 17 have resulted in improved recreation special use management and reduced user conflicts. The quality of recreation experiences for residents, the general public, and outfitter/guide clients has been increased. However, alternative A has no requirement to extend these provisions to the rest of the forest. This would result in inconsistent special use management, visitor and guide frustration, and increased user conflicts.

Alternative B (modified)

Alternative B (modified) differs from alternative A in that much of the direction contained in amendments 12 and 17 would apply forestwide. For example, amendment 12 direction for the Honanki heritage site was modified under this alternative to be a guideline (FW-SecUse-G-20) that applies to any developed heritage site on the forest. Broadening the language would allow the forest to manage similar resources with more consistency. As a result, the recreation experience for guided and unguided activities would be more consistent and would better meet visitor expectations in terms of settings and social encounter levels.

Changes in the ROS classifications on the forest would alter where some of the language carried forward from amendment 12 and 17 applies on the ground. These changes would affect how and where future permits are issued in a manner similar to the restrictions in the amendment 12 and 17, which would result in some limitations on where recreational special uses would occur and how many permits would be issued in high use areas."

Much of the administrative direction from alternative A was dropped because it repeated law, regulation, and policy, but direction on prioritizing prospectuses and coordinating with other agencies was retained to emphasize their importance to the overall program.

The limited new direction proposed in alternative B (modified) captures strategies that have been used on the forest for some time and does not constitute a change from the current condition or management strategies. For example, alternative B (modified) codifies the forest's practice of authorizing only non-motorized activities at organization camps (FW-SpecUse-DC-11). This would not prevent organization camps from using vehicles to transport participants on the forest for a non-motorized primary activity. As a result, these facilities would continue to provide youth access to natural resources education through non-motorized means and would be able to lead guided activities on the forest as part of their overall camp program. They would not be able to provide motorized recreation opportunities to participants.

This alternative would create new limitations on where special-use permits can occur in order to protect natural resources and visitor experiences. It would limit permitted activities in riparian areas unless the site is hardened (such as slick rock areas), the use is a water-dependent activity, or the use is safety-related (FW-SpecUse-G-3). This guideline provides additional protections for riparian resources and springs and would result in fewer impacts from recreations, such as vegetation trampling and soil compaction and loss. Wild and scenic rivers are exempted from this guideline because they have their own more site-specific management plans (see Special Areas).

For safety and access purposes, this alternative also includes a guideline that states that recreation events on Snowbowl Road (FR 516) should be infrequent and should not interfere with the use of the area by the general public or permittees near the Snowbowl Ski Area (MA-Peaks-G-2). This road is a popular place for bicycling, running, and other events. However, permitting events along this road creates safety hazards, as it adds runners and bicyclers to a high-use road that has little to no shoulder. The only mitigation to these safety risks is to close the road during the event. Limitations on recreation events on

this road would maintain access for the general public wanting to utilize the Kachina Peaks Wilderness, Arizona Snowbowl Ski Area, and the adjacent general forest areas. The guideline would, however, reduce the ability of organizations to offer events on a steep and winding road, as there are few other places in northern Arizona that provide this setting. This guideline would not limit the ability to permit activities that use Arizona Snowbowl as a staging area and access the surrounding general forest area.

As part of special use permits, another guideline allows livestock in areas without suitable forage or water without restricting the activity entirely by having the permittee haul feed or water to the site (FW-SpecUse-G-21). A guideline would also mitigate the risk of spreading invasive weeds by introducing seeds though recreational livestock use (FW-Rec-All-G-6). This would create some additional burden for pack stock to carry their own food, but would permit use of some unique recreational settings for horse and pack stock guides that would otherwise negatively impact vegetation communities.

This alternative contains an objective that directs the forest to identify sites suitable for large-group activities, such as a recreation events and weddings (FW-SpecUse-O-1). These sites would be analyzed and approved for these uses through the NEPA process. This would streamline the special use permitting process for these types of events by eliminating the need to identify and analyze sites on a case-by-case basis. This alternative would direct the forest to identify at least 4 of these sites within 10 years of plan approval. Other direction is to provide a diversity of locations and to determine a group-size capacity for each site (FW-SpecUse-DC-9). This would allow the forest to be more responsive in meeting the public need for large-group gatherings and to provide better customer service to prospective permittees.

Alternative C

The environmental consequences associated with recreation special uses for alternative C are the same as in alternative B (modified) except that alternative C would not allow large groups, events, or commercial tours in eight management areas that are being managed for reduced human-related disturbance (Anderson Mesa, Blue Ridge, Hospital Ridge, Jack's Canyon, Knoll Lake, Limestone Pasture, Pine Grove, and Second Chance management areas). The activities would be displaced to other parts of the forest. Similar activities would be further restricted by the approximately 92,000 acres of additional recommended wilderness because they are typically not allowed in wilderness areas. Approximately 68 percent of the forest would still be available for these uses, and the objective to identify sites appropriate for large-group activities (FW-SpecUse-O-1) would help redirect these users to where their use may be authorized. Because these types of activities are managed under special-use permit, the forest has the ability to mitigate the potential for overcrowding, by directing groups to locations away from one another.

Alternative D

The environmental consequences associated with recreation special uses for alternative D would be the same as in alternative B (modified).

Cumulative Effects

Cumulative effects are the consequences of past, present, and foreseeable activities on Federal and non-Federal lands that, in conjunction with management activities likely to occur on the forest, may intensify, negate, improve, or otherwise affect the recreation resource on the forest. Below are considerations of consequences of activities that would likely occur on adjacent or nearby ownerships to the forest.

The analysis timeframe for cumulative effects to recreation is the next 10 to 15 years.

The analysis area for cumulative effects includes the Coconino NF and adjacent lands in northern Arizona: the Kaibab, Prescott, and Tonto National Forests; Grand Canyon National Park; Navajo Nation lands; multiple national monuments; multiple Arizona State Parks; and various County and local

parklands. These public lands provide a wide range of recreation opportunities, but differences in agency missions often result in different types of recreation experiences. The National Park Service provides highly developed and managed visitor facilities in front country locations and back-country opportunities by permit. The BLM and other national forests provide a broad range of opportunities with less developed facilities. Arizona State Parks typically emphasize a particular land feature, such as a lake, and offer related recreation opportunities such as boating, fishing, swimming, and camping. Local and county park facilities are typically oriented toward day users (some offer camping) and more urban recreation opportunities such as volleyball and basketball.

Past Actions

The Walnut Canyon Study (2014) was a joint initiative of the Forest Service and National Park Service to explore management options for an area of land surrounding Walnut Canyon National Monument. The study examined whether to designate the area as an addition to the national monument, to maintain existing Forest Service management, or to identify another option for managing these lands. The study identified three actions for Congressional consideration: continuation of current management by the Forest Service; establishing a special designation to the Study Area; and prohibiting the exchange of the lands to any entity other than Federal land management agencies. Depending which action the Secretary of Agriculture selects, recreation management will be affected. If the lands stay under the jurisdiction of the Forest Service, recreation management will likely remain the same. Special designation could include restrictions to recreation management or development, depending on the language included in the designation.

Present and Future Actions

Adjacent national forests, Arizona State Parks, and local municipal lands have various management plans addressing recreation. The Coconino NF has been a collaborative partner in the development of many of these plans, especially at the local community level (i.e., Flagstaff, Sedona, and Verde Valley communities). In general, these various plans call for increasing trail systems and other recreation facilities to meet increasing demand. There is also an increased focus on managing recreation sustainably and in collaborative management across ownership boundaries. The alignment of recreation goals across agencies will enhance and improve recreation opportunities in and adjacent to the Coconino NF.

Under the Four-Forest Restoration Initiative (4FRI), an estimated 50,000 acres of ponderosa pine forest would be treated per year by thinning and/or prescribed burn. This initiative covers four national forests (Apache-Sitgreaves, Coconino, Kaibab, and Tonto) and covers a period of 20 years. Much of the summer recreation on national forests in Arizona occurs in these areas as people seek relief from the heat. The extensiveness of these treatments in some areas could temporarily displace recreation users from the areas being treated. These users would likely shift to other dispersed recreation areas of the forests, causing an increase in use, and by extension potential crowding, in those areas. This effect would be temporary, however, and would only last for the duration of the management activities within any given area.

Common to All Alternatives

Within the planning period, human population growth—as well as growth and demand for a variety of recreation opportunities—is expected to increase. Arizona's population has been growing at a greater rate than the national average, and this trend is likely to continue throughout the life of this plan. The growing population would place increasing demands on recreation, resulting in higher levels of use, increased conflicts, and reduced quality of experience. The increasing levels of motorized recreation would result in increased conflict between motorized and non-motorized user groups throughout the cumulative effects analysis area. As the demand for outdoor recreation grows, land management agencies would find it increasingly difficult to meet the needs of all user groups. Semiprimitive and primitive settings are especially vulnerable as larger segments of the population demand motorized opportunities.

As forest areas near urban population centers (Phoenix, Prescott, and Flagstaff) become increasingly crowded, users wishing a recreation setting with more solitude will be displaced to other areas. The Kaibab NF (which is more removed from these population centers than the Tonto, Prescott, and Apache-Sitgreaves NFs) would likely see an increase in this type of use, which ultimately would lead to increased crowding in those areas as well. Without active management to protect semiprimitive non-motorized and primitive experiences, these opportunities are likely to be lost in the face of increasing pressure for motorized recreation.

With population increases in Arizona there will continue to be increases in development infill (housing and commercial services) on private and municipal lands. This will cause increases in the existing forest urban interface and associated recreation dispersal from these areas onto NFS land. In order to provide services to for infill, there will be need for additional utilities and utility corridors and communication sites and infrastructure, and potential for development of energy sources for growing communities. As a result, there will be a greater need for cooperation and collaboration with adjacent landowners to increase awareness and education, and to partner in protection of natural resources and sustainable recreation activities.

The Arizona Department of Transportation (ADOT) 2014-2018 Five-Year Transportation Facilities Construction Program lists projects on or in the vicinity of the Coconino NF and the nearby national forests. These planned projects consist of pavement rehabilitation, shoulder widening, passing lane additions and other heavy maintenance projects. None of these projects would increase or decrease access to the national forests. In all alternatives, these road improvements could facilitate increases in forest visitors since the driving times from the urban areas of Phoenix and Tucson would decrease. As use increases, compliance with regulation could become a greater challenge as visitors often compete for limited space and resources. There are more recreation opportunities available in the more developed ROS settings (urban, rural, roaded natural ROS classes), and expectations for these include higher encounter levels, more facilities, and more evidence of humans. In contrast, there are fewer recreation opportunities available in more primitive ROS settings (semiprimitive motorized, semiprimitive nonmotorized and primitive ROS classes or wilderness opportunity classes). The more primitive settings emphasize solitude, challenge, risk, unmodified natural environments, and minimal encounters and/or signs of other users.

As Arizona’s population and available access increase, the demand for recreational opportunities and open space will grow. The demand for utilities to serve a growing population will also grow. However, the land and resources required to provide these opportunities are finite. There are more developed recreation opportunities provided by nearby forests, other Federal agencies, State Parks, Coconino County, municipalities and private entities. For example, state lands within or near the boundaries of the forest have a variety of uses, including State parks such as Deadhorse Ranch State Park, which is adjacent to the forest and shares a common boundary with the Verde Valley Botanical Area. Main uses of Deadhorse Ranch State Park include such recreational activities as camping, hiking, horseback riding, and fishing. Areas like this help to meet the demands of a growing population and to provide a variety of activities for people to engage in. Provision of more primitive opportunities is more at risk. There is already a high demand for more primitive settings. While there are primitive opportunities provided by adjacent forests and Federal agencies, it is unlikely that the demand for such areas will be satisfied over time.

There are a number of planned connecting trail systems being considered by communities, including completion of the Flagstaff loop trail, as well as Prescott and Payson plans to connect with Forest Service trails. In alternative A, there is direction for working with other jurisdictions to plan and construct connecting trails. In alternatives B (modified), C, and D, there is supportive language and direction for

trail connectivity. Cumulatively for these alternatives, as these trail systems are constructed, these will lead to better opportunities for all users.

Special Areas

This section evaluates and discloses the potential affected environment, environmental consequences, and cumulative effects on special areas that may result with adoption of a revised land management plan. For each area, the affected environment and environmental consequences are provided separately, followed by a summary of the cumulative effects for all special areas.

Wilderness and Wild and Scenic Rivers

Affected Environment

Ten separate designated wilderness areas comprise 156,374 acres of wilderness on the Coconino NF (see appendix A, map 29). Eight of the wilderness areas are managed by the Coconino NF forest plan. Kendrick Mountain Wilderness and Mazatzal Wilderness are managed by the forest plans of adjacent national forests (Kaibab NF and Tonto NF, respectively). Wilderness visitation is increasing on the Coconino NF, and although the majority of wilderness on the Coconino NF is able to support wilderness characteristics with minimal management interference, recreation impacts (such as the creation of social trails),and high encounter levels in the most popular wilderness areas are fairly common. In some cases, the encounter levels are so high that they become contradictory with those typically described in wilderness character. Wilderness areas around Sedona are regularly impacted by aerial tours whose low altitude and noise disrupt wilderness characteristics through the sights and sounds of human presence. Motorized and mechanized use is not allowed in wilderness areas. This restrains management activities that require the use of motorized equipment or vehicles such as some vegetation or fire treatments in some portions of designated wilderness. Not all designated wildernesses are in need of restoration due to cliffs, talus slopes, or other elements of topography. However, some areas that would benefit from treatment such as fuels reduction would not be treated. This could result in a buildup of fuels and lead to a higher risk of uncharacteristic fire in frequent fire ERUs. Uncharacteristic fire could degrade wilderness characteristics.

The Forest Service must evaluate lands that meet the inventory criteria for potential wilderness during plan revision and consider alternatives for recommending wilderness. Recommended areas would be managed to maintain their wilderness characteristics until they are officially designated by Congress and added to the National Wilderness Preservation System. Under alternative B (modified), Abineau, Davey's, and Strawberry Crater potential wilderness areas are recommended, and under alternative C, the areas from alternative B (modified) and Hackberry, Cimarron-Boulder, Tin Can, Black Mountain, Cedar Bench, Deadwood Draw, East Clear Creek, Barbershop, Railroad Draw, and Walker Mountain are recommended as well (see table 48 for acres for each recommended wilderness area)(see appendix A, map 29). For more information on the process for selecting recommended wilderness for plan alternatives, see the "Wilderness Area Evaluation Report" (USDA Forest Service 2016e). Alternatives A and D recommend no new wilderness areas.

There are four designated wild and scenic river segments on the Coconino NF: Fossil Creek Recreational River (7.2 miles), Fossil Creek Wild River (7.2 miles), Verde Scenic River (18.4 miles), and Verde Wild River (10.7 miles). The Verde Wild and Scenic River has a comprehensive river management plan that addresses recreation and its associated impacts. Fossil Creek was designated in 2009 as a wild and scenic river. Formerly dammed and diverted for use in hydropower generation, the restored Fossil Creek has become a magnet for recreation users and has had a rapid increase in visitation. Currently, an interdisciplinary team is working on its comprehensive river management plan.

Table 48. Recommended wilderness

Recommended Wilderness –Alternatives B (modified) and C	Acres
Abineau	415
Davey's	1,739
Strawberry Crater	6,579
Additional Recommended Wilderness – Alternative C	**Acres**
Barbershop	1,305
Black Mountain	9,715
Cedar Bench	5,782
Cimarron Boulder	15,124
Deadwood Draw	11,775
East Clear Creek	1,986
Hackberry	25,836
Railroad Draw	1,220
Tin Can	3,905
Walker Mountain	6,377

The Coconino NF has 11 eligible wild and scenic river segments totaling approximately 180.9 miles of perennial rivers. Forest Service policy protects the outstandingly remarkable values of eligible segments until their suitability is determined (SA-WSR-G-1). More information on eligible segments and how their eligibility was evaluated can be found within the "Eligibility Review for the National Wild and Scenic River System Report" in the project record, which is summarized in table 49. Congressional action is required for any of these eligible segments to be designated as wild and scenic rivers.

Table 49. Summary of eligible wild and scenic rivers on the Coconino NF

Eligible River Segment	Classification	Outstandingly Remarkable Values	Miles[1]
Barbershop	Wild	Scenery, Fish	13.5
East Clear Creek	Scenic	Scenery, Fish	38.6
Leonard Canyon	Recreational	Geology	23.5
Oak Creek Segment 1	Recreational	Scenery, Recreation, Geology, Fish, Vegetation/Ecological Values, Other (Riparian)	13.2
Sycamore Creek	Wild	Recreation, Fish, Other (Riparian)	4.1
Upper Verde River[2]	Recreational	Scenery, Cultural, Fish, Wildlife	6.7
West Clear Creek Segment 1	Wild	Scenery, Recreation, Fish, Wildlife, Vegetation/Ecological Values, Other (Riparian)	32.5
West Clear Creek Segment 2	Scenic	Scenery, Recreation, Fish, Wildlife, Vegetation/Ecological Values, Other (Riparian)	6.3
West Fork of Oak Creek	Recreational	Scenery, Recreation, Geology, Fish, Vegetation/Ecological Values, Other (Riparian)	10.5
Wet Beaver Creek Segment 1	Wild	Scenery, Recreation, Geology, Fish, Vegetation/Ecological Values, Other (Riparian)	13.6
Wet Beaver Creek Segment 2	Recreational	Scenery, Recreation, Geology, Fish, Vegetation/Ecological Values, Other (Riparian)	5.0

[1] Miles for each segment were calculated using updated GIS calculations based on the starting and ending point described for each segment. These numbers do not match the "Preliminary Analysis of Eligibility and Classification for Wild/Scenic/Recreational River Designation" (1993) report as a result of the updated GIS calculations.

[2] This segment of the Verde River is in addition to the already designated Verde River segments (one wild, one scenic).

Environmental Consequences

Common to All Alternatives

All alternatives carry forward the need for patrols, wilderness rehabilitation of impacted sites, education, and wilderness-specific management plans. Collectively, this would reduce or mitigate recreation impacts and maintain wilderness characteristics especially in high-use areas, and high encounter levels in the most popular wilderness areas are fairly common. In some cases, the encounter levels are so high that they may diminish the wilderness experience of visitors. Wilderness areas around Sedona are regularly impacted by aerial tours whose low altitude and noise disrupt wilderness characteristics through the sights and sounds of human presence.

Some wilderness-specific prohibitions on off-trail use, camping, campfires, and horse and pack stock use have also been carried forward because of the importance of maintaining these restrictions to achieve desired conditions. Other plan language would limit group size to 12 persons and stock animals combined and would only allow commercial and organizational group activities that promote wilderness values. These restrictions would reduce high encounter levels, protect wilderness resources, and promote a wilderness experience for visitors. There are no changes in effects to wilderness areas and wild and scenic rivers from this direction among alternatives A (1987 Plan, pages 22, 24, 50, 64-65, 65-3, 70-1, 70, 83, 84, 88, 89, 90, 94, 98 to 108, 108-1 to 108-2, 108-3 to 108-4, 109 to 112), B (modified), C, and D (SA-Wild-DC-1 to DC-11, SA-Wild-O-2, SA-Wild-S-1 and 2, SA-WSR-G-1, SA-WSR-MgtApp).

Wild and scenic rivers are managed under comprehensive river management plans. In alternative A, the "Verde River Comprehensive River Management Plan" is incorporated as management area standards and guidelines (1987 Plan, pages 113 to 115, 115-1 to 115-5). In alternatives B (modified), C, and D, it is incorporated by reference, which provides the same level of direction. The "Fossil Creek Wild and Scenic River Comprehensive River Management Plan's" desired conditions, standards, and guidelines would improve protection of the resources in the river corridor and potentially limit recreational access to the river and restrict dispersed camping. Some of these changes, such as restricting dispersed camping along the river would be consistent with guidelines in alternatives B (modified), C, and D for recreation in these areas. Like the Verde Wild and Scenic River, the "Fossil Creek Wild and Scenic River Comprehensive River Management Plan" would not necessarily have to correspond to broader forestwide plan direction.

The 11 eligible wild and scenic rivers would have their eligibility maintained in accordance with Forest Service Manual and Handbook direction until they are evaluated for their suitability and either designated or released. This means that they would be maintained in their free-flowing condition, and their identified outstandingly remarkable values would be retained.

Under all alternatives, the plan would eventually be amended to incorporate direction from the "Arizona Trail Comprehensive Management Plan." The Arizona Trail Comprehensive Management Plan's direction would improve protection of the national scenic trail, use partnerships to manage it, and promote appropriate recreational uses. These changes would be consistent with guidelines in alternatives B (modified), C, and D for recreation along the trail though could result in potential enhancements to scenery management and ROS objectives. Like the Verde Wild and Scenic River, the "Arizona Trail Comprehensive Management Plan" would not necessarily have to correspond to broader forestwide plan direction.

Alternative A

Alternative A's guidance for wilderness is outdated; redundant with existing law, regulation, and policy; or largely ineffective. Several components direct the forest to take corrective measures if overuse results

in unacceptable resource damage (1987 Plan, pages 108-3, 110) and to keep all the areas open to horses unless specifically restricted (1987 Plan, page 108-4). These components have no measureable effect on the wilderness resource, because they do not limit or compel any particular action. Instead, they state general principles that sites should be restored.

In alternative A, there is a partial schedule of projects (1987 Plan, pages 74, 106 to 108, 108-1 to 108-2, 108-3 to 108-4, 109 to 112) to be carried out following plan approval. Some of these have been accomplished, but others such as use of fire have been difficult to implement, and overall, there is no clear explanation of the wilderness setting these projects were intended to create. This schedule no longer reflects the management needs of designated wilderness on the forest and, therefore, provides no strategic value on how to manage areas where human activities have altered wilderness characteristics. Alternative A would result in a less efficient distribution of resources to respond to management issues in wilderness and would have less direction to inform decision makers on the desired outcomes for intervention in wilderness. As a result, there would be little to no restoration activities under alternative A to improve wilderness characteristics.

Other guidelines repeat law, regulation, and policy about designated wilderness (1987 Plan, page 108-1). These guidelines have resulted in narrow trail footprints, increased access across private land, consolidation of redundant trails, limitations on camping in high use areas, loop hikes, and increased awareness and wilderness education (1987 Plan, pages 108-2, 108-3 to 108-4), which would have occurred anyway, given direction in other components in this alternative. Of the wilderness-specific standards and guideline in the 1987 plan, only a few have on-the-ground impacts. A standard limits horse and pack stock use on the Weatherford Trail above Doyle Saddle (Kachina Peaks Wilderness, on Fay, Wilson Mountain, West Fork of Oak Creek, Devil's Bridge and Boynton Canyon Trails in Red Rock-Secret Mountain Wilderness (1987 Plan, page 90). The highest elevations of Kachina Peaks are open to day-use foot traffic only along the Humphreys Peak trail and from Humphreys Peak to Doyle Saddle along the ridge (1987 Plan, page 108) and access is limited to designated trails on 325 acres of alpine areas in Kachina Peaks to protect sensitive native plant communities (1987 Plan, page 110). This guidance would prevent improvement to some trailheads to accommodate horse trailers. This restriction also protects sensitive alpine native plant communities from weed introduction and trampling. This plan direction is carried forward under all alternatives (SA-Wild-S-3, SA-Wild-S-4, SA-Wild-S-5).

One guideline that has never been implemented is a wilderness permit system in the heavily used Red Rock-Secret Mountain Wilderness for day use and overnight camping (1987 Plan, page 108-3). This would meet the management emphasis in this wilderness to have people experience solitude, natural quiet, self-discovery, and self-reliance and would help meet the recreation goals of maintaining the Pristine and Primitive WOS/ROS settings (1987 Plan, page 108-1). It would also help meet the recreation goals of maintaining wilderness values and protecting visitor experiences and resources. Resources, security of residences on adjacent private land, and sanitation would be protected. Other plan direction would protect visitor experiences and resources by designating camp areas consistent with protection of threatened, endangered and sensitive species. If implemented, these guidelines would reduce the ability of the residents of Sedona to regularly use trails in this wilderness, because there would be a limited number of permits available and some portion would be taken by non-residents. It could likewise limit the ability of tourists to access this wilderness for the same reason. Implementing a permit system in the Red Rock-Secret Mountain Wilderness would displace visitors seeking a wilderness experience in red rock country to the Munds Wilderness (which has much lower use outside of the Bell Rock area) and would impact the wilderness characteristics and increase the number of encounters in this wilderness. Other users may be displaced into less congested areas, non-wilderness areas or areas with red rock features outside of wilderness such as Crescent Moon Ranch and Cathedral Rock.

Another guideline limits commercial uses in the Red Rock-Secret Mountain and Munds Wilderness areas to designated campsites and trails (1987 Plan, page 108-4), which is common practice in outfitter-guide permits throughout the Sedona-Oak Creek area. The consequence of this direction would be to concentrate permits for outfitter-guides in areas that already have evidence of human activities. However, this is already standard practice for the district's outfitter/guide management and so would have negligible impacts.

One goal in the Red Rock-Secret Mountain, Munds, and a portion of the Sycamore Wilderness Areas is to have uses adjacent to these wilderness areas that are consistent with wilderness values (1987 Plan, page108-1). This goal would promote protection of wilderness characteristics on the edges of these areas through the awareness of the potential impacts to wilderness characteristics such as noise intrusions from motorized traffic. However, this goal conflicts with the Arizona Wilderness Act of 1984 (P.L. 98-406) which states, "The Congress does not intend that designation of wilderness areas in the State of Arizona lead to the creation of protective perimeters or buffer zones around each wilderness area. The fact that non-wilderness activities or uses can be seen or heard from areas within a wilderness shall not in and of itself preclude such activities or uses up to the boundary of the wilderness area." The Forest Service, therefore, can analyze the effects of adjacent uses on wilderness characteristics as part of an environmental analysis, but by law, it cannot base management decision solely on this issue. This goal is thereby misleading because the Forest Service does not have the authority to enforce it.

Alternative A would not recommend any new wilderness areas on the Coconino NF and does not include any recommendation to manage areas that might be recommended in the future. The forest would continue to have 10 designated wilderness areas and no recommended wilderness areas, totaling 156,374 acres. Under this alternative, 156,374 acres would be designated wilderness or classified as Primitive ROS. Accordingly, this alternative would do nothing toward meeting the demand for wilderness areas and their associated primitive, undeveloped settings. Given the increasing share of visitation on the Coconino NF that is focused on wilderness, it is likely that existing wilderness would continue to see high visitation and that there would be fewer opportunities for solitude. High use could result in the creation of social trails and new dispersed camping sites. This could negatively impact soil, water, and vegetation resources and wildlife habitat, and would result in decreases in wilderness characteristics and opportunities for primitive and unconfined recreation.

Because alternative A recommends no new wilderness areas, it adds no new prohibitions or geographic restraints on management activities and uses. The existing prohibitions and geographic restraints on management activities and uses associated with the 10 designated wilderness areas would continue on 156,374 acres, which is about 8 percent of the forest.

Wild and scenic rivers are managed under comprehensive river management plans. Fossil Creek's comprehensive river management plan has not yet been completed, and the 1987 plan is silent on its management and lacks direction for the 11 eligible wild and scenic river segments on the forest.

Alternative B (modified)

Alternative B (modified) would retain the 10 existing wilderness areas totaling 156,374 acres, and would recommend three additional wilderness areas: Abineau (415 acres), Davey's (1,739 acres), and Strawberry Crater (6,579 acres). The recommended wilderness would total 8,733 additional acres. Total acres of designated wilderness, recommended wilderness, and areas classified as Primitive ROS would be 165,107 acres, about 9 percent of the Coconino NF. This alternative would meet some of the increasing demand for wilderness recreation settings. There would be more opportunities for solitude in wilderness than under alternative A, as a result of the three new recommended wilderness areas that could provide these opportunities. Current trends of high use at specific locations at Kachina Peaks, Red Rock-Secret Mountain, Munds and West Clear Creek Wilderness areas would continue to grow and it is likely that use

at other wilderness portals in these places and at the other existing wilderness areas would increase as well. High use could result in the creation of social trails and new dispersed camping sites. This could negatively impact soil, water, and vegetation resources and wildlife habitat and would result in decreases in wilderness characteristics and opportunities for primitive and unconfined recreation.

Forestwide and management area direction in alternative B (modified) would maintain soil function, long-term soil productivity, and desired conditions for associated resources (e.g., riparian areas and water) by managing dispersed camping outside of riparian areas or in such a way to move toward desired conditions for riparian areas (FW-Rec-Disp-G-5, MA-LongV-G-1, and MA-EastClr-G-1). A plan component in the section on Special Uses would protect a 200-foot buffer adjacent to streams, springs, waters, and riparian areas that contribute or support sensitive resources (FW-Rec-Disp-G-5). This component would not allow land and recreation special use permits to be issued for activities proposed to occur in these areas. Exceptions could be made for hardened or slickrock sites, water-dependent activities, or safety (FW-SpecUse-G-3). A guideline under Recreation Special Uses would exclude outfitter-guide activities (e.g., camping and motor vehicle use) from areas such as riparian areas with sensitive resource issues to prevent soil compaction and overutilization of popular areas (FW-Spec-Use-G-18). Another guideline would protect sensitive resources (such as riparian areas) and would minimize impacts by permitting large group gatherings and recreation events in previously approved areas or suitable developed sites (FW-SpecUse-G-19). Finally, recreation and other activities at designated and eligible wild and scenic rivers and the associated corridors would be managed to protect and enhance the free-flowing condition and the outstandingly remarkable values consistent with the classification (SA-WSR-G-1). Therefore, camping would either be prohibited by this alternative, or the forest would need to develop a strategy for identifying and designating campsites where impacts to riparian resources could be mitigated. In either case, the recreation opportunities for this area would be greatly reduced. This would be beneficial in all special areas by enhancing visitor experiences, maintaining wilderness characteristics, and maintaining or enhancing outstandingly remarkable values in designated or eligible wild and scenic rivers.

The biggest difference pertaining to wilderness between alternative A and alternative B (modified) is that alternative B (modified) has updated plan components that address current and ongoing concerns and themes regarding wilderness. High recreation use and motorized and mechanized intrusions are addressed via effectively managed boundaries, consistency with the wilderness opportunity spectrum, and education and interpretation (SA-Wild-DC-6, 7, 8, 9, 10, SA-Wild-S-1, SA-Wild-G-2, 3, 4, 5, 6, 8, 10, and 11). These are intended to maintain cultural values; unique features; and wilderness values, opportunities, and characteristics. Plan components would maintain ecological values, maintain properly functioning ecosystems that reflect natural processes, support a natural array of indigenous species and their habitats, and protect rare species within wilderness (SA-Wild-DC-1, 2, 3, 4; SA-Wild-S-3, 4, 5; SA-Wild-G-8, 9, 10, and 11). There would be more opportunities to treat fire-adapted ERUs with fire and restore natural processes compared to alternative A. This is because alternative B (modified) removes some of the constraints to using fire that are in alternative A, and other plan components promote wildland fires within historic fire regimes providing conditions permit, providing fire management is consistent with maintain or moving toward desired conditions for other resources, and providing fires don't result in loss of life, property, or ecosystem function (SA-RWild-DC-1, 2, FW-Fire-DC-2, 3), FW-TerrERU-All-DC-2, and FW-Fire-G-2). Finally, a desired condition promotes the tribal and cultural importance of the San Francisco Peaks within the Kachina Peaks Wilderness (SA-Wild-DC-5). Alternative B (modified) has further guidance that would promote the maintenance and enjoyment of wilderness characteristics. Instead of stating that commercial uses should be limited without clear indications to what end these limitations would be working toward like in alternative A, alternative B (modified) has a desired condition that these activities facilitate protection, education, and/or the enjoyment of wilderness characteristics; do not detract from the wilderness experience of others; and do not cause widespread negative impacts to wilderness characteristics. There is also guidance that large group activities should

not occur in wilderness (SA-Wild-DC-11, G-3). The direction under alternative B (modified) provides a clearer framework to help managers identify whether an activity is appropriate for the wilderness. This would be especially helpful for outfitter-guide management, where the Wilderness Act and national policy make only broad, general statements. This would allow managers to authorize outfitter-guide activities where appropriate, providing the public with increased opportunities to experience guided wilderness experiences.

Alternative B (modified) also recognizes the importance of rehabilitating sites where wilderness characteristics have been impacted. The objective would be to continue to rehabilitate 10 to 50 impacted sites within 10 years of plan approval (SA-Wild-O-1). This objective would continue the forest's current rate of managing impacts and would be sufficient to move toward desired conditions in most wilderness areas, given current patterns of use and a moderate expected increase in visitation.

The two standards in alternative A that limit horse and pack stock and overnight camping above timberline in the Kachina Peaks Wilderness were carried forward into alternative B (modified) (SA-Wild-S-4). This adjustment would allow for horse and pack stock to be used in wilderness management when they are appropriate under the Minimum Requirement Decision Process, but would not change trail or trailhead maintenance or restrictions on public use of horse and pack stock on these trails. Inclusion of these standards in alternative B (modified) would continue to protect this important watershed from potential impacts from horse and pack stock, which include removal for herbaceous vegetation and transmission of invasive plants.

A management approach in the Wildlife, Fish, and Plant section would remind managers to maintain the native-fish-only status of Fossil Creek and streams free of non-natives through public education, signs, and law enforcement. This would help maintain the wilderness characteristics in the Fossil Creek Wilderness and would help maintain wildlife, which is one of the outstandingly remarkable values in Fossil Creek for which the wild and scenic river was designated.

Desired conditions for wilderness would maintain wilderness characteristics by promoting properly functioning ecosystems and ecological resources that reflect natural process (SA-Wild-DC-2). A wilderness guideline would move toward desired conditions and help maintain one of the outstandingly remarkable values in Fossil Creek by assuring that projects and activities be designed to maintain the travertine formations and water chemistry of Fossil Creek in the Fossil Creek Wilderness (SA-Wild-G-8).

A desired condition in alternative B (modified) would protect the free-flowing nature of Fossil Creek and its character (SA-WSR-DC-1). This alternative also states that the interim guidance for the Fossil Creek Wild and Scenic River (SA-WSR-G-1) should be followed until the comprehensive river management plan is complete and incorporated by reference. This is intended to preserve and maintain the outstandingly remarkable values for which it was designated. Comprehensive river management plans are revised and updated through a process separate from plan revision. There is no direction in alternative A for eligible wild and scenic rivers. Alternative B (modified) would provide additional guidance for maintaining their free-flowing condition, and retaining their identified outstandingly remarkable values (SA-WSR-DC-1, SA-WSR-DC-2, SA-WSR-DC-4, SA-WSR-G-1).

Alternative B (modified) recommends three new wilderness areas totaling 8,733 acres (Strawberry Crater, Abineau, and Davey's), which is less than 1 percent of the forest. These would expand the existing Strawberry Crater Wilderness, Kachina Peaks Wilderness, and Fossil Creek Wilderness, respectively. Alternative B (modified) better addresses the need for increased wilderness visitation on the forest than alternative A, because it increases the area available for wilderness in locations close to the largest population centers (e.g., Phoenix, the Verde Valley, and Flagstaff) and would increase opportunities for wilderness experiences on the forest. These areas would decrease opportunities for mechanized recreation

if these areas are designated by Congress; however, mechanized recreation is allowed in recommended wildernesses at levels that maintain and do not detract from wilderness values (SA-RWild-DC-6). New trails would not be designed for non-motorized and non-mechanized activities to preserve the area's wilderness characteristics (SA-RWild-G-5). New trail construction in recommended wilderness would be limited to hiking and horseback riding design standards (SA-RWild-G-5). Maintenance of existing trails would retain or restore the primitive setting, which means they would rarely use materials brought in from other locations or artificial materials such as metal culverts (SA-RWild-G-4). Stairs and more developed trail design features would be infrequent except where soil and water resources are impacted by heavy recreation use. Consequently, visitor wilderness-related experience would be enhanced by maintenance of primitive settings and local materials, but mechanized recreation would not be emphasized. Recreation users would continue to have access to these opportunities, but would not have the opportunity to have trails improved for better mountain bike experiences.

The areas recommended for wilderness designation under alternative B (modified) are not open to public motorized travel under the current motorized vehicle use map, so this alternative would not further limit current motorized public access to these areas. It would prevent the construction of new roads or motorized trails in these areas. Only 0.1 mile of road occurs in these three recommended wildernesses. This road in the Strawberry Crater recommended wilderness is designated as administrative use only, which is consistent with a guideline that allows motor vehicle use only for limited administrative and permitted activities (such as the maintenance of grazing facilities) and as defined on motor vehicle use and over-snow vehicle maps (SA-RWild-G-3). This would maintain the areas wilderness characteristics. Hunting and scouting would be allowed as long as it was non-motorized in the recommended wilderness. This would result in reduced hunting access for individuals who are mobility impaired. Motorized big game retrieval would be allowed, until areas are congressionally designated as wilderness. Depending on the amount of use, big game retrieval could reduce visitors' opportunities for solitude. A substantial portion of these areas has terrain that is not passable by vehicle, and so, even though it is within an area that would allow for big game retrieval, it is unlikely to occur.

Alternative C

Except as noted below, the environmental consequences associated with designated wilderness and wild and scenic rivers in alternative C are the same as those found in alternative B (modified).

Like alternative B (modified), alternative C would retain the 10 existing wilderness areas and recommend three additional wilderness areas: Abineau, Davey's, and Strawberry Crater. Alternative C also includes 10 additional recommended wilderness areas: Barbershop (1,305 acres), Black Mountain (9,715 acres), Cedar Bench (5,782), Cimarron-Boulder (15,124 acres), Deadwood Draw (11,775 acres), East Clear Creek (1,986 acres), Hackberry (25,836 acres), Railroad Draw (1,220 acres), Tin Can (3,905 acres), and Walker Mountain (6,377 acres). The 13 recommended wilderness areas would total 91,757[37] acres. Acres of designated wilderness, recommended wilderness, and areas classified as Primitive ROS would total 248,131 acres. This alternative would provide the greatest increase in the opportunities for wilderness experience on the forest. This alternative addresses increased wilderness visitation on the forest better than alternatives A or B (modified), because it provides the most acreage and the largest variety of new wilderness opportunities. Given the increasing share of visitation on the Coconino NF that is focused on wilderness, it is likely that existing wilderness would continue to see high visitation. Current trends of high use at specific locations at Kachina Peaks, Red Rock-Secret Mountain, Munds and West Clear Creek Wilderness Areas would continue to grow, and it is likely that use at other wilderness portals in these places and at the other existing wilderness areas would increase as well. High use would result in decreases in wilderness character and opportunities for primitive and unconfined recreation. However,

[37] The 91,757 acres includes 905 acres of Hackberry Wilderness, which extends onto the Prescott NF.

there would be more opportunities for solitude in primitive environments than under alternatives A or B (modified) because of the 13 new recommended wilderness areas that could provide these opportunities in less well-known areas.

In the 10 additional recommended wilderness areas included in this alternative, approximately 10.6 miles of roads are open to public motorized travel under the most current motor vehicle use map, primarily in Black Mountain and Cedar Bench. These roads, in addition to the 0.1 mile of road in the Strawberry Crater recommended wilderness, would be designated for administrative use only. This is consistent with a guideline that allows motor vehicle use only for limited administrative and permitted activities (such as the maintenance of grazing facilities) and as defined on motor vehicle use and over-snow vehicle maps (SA-RWild-G-3). An additional 5.1 miles of roads in these 10 additional recommended wilderness areas are authorized for administrative purposes such as fire and grazing management. They would continue to be authorized for these purposes under this alternative. As recommended wilderness areas, there are no provisions for the construction of new roads or motorized trails (SA-RWild-DC-5, SA-RWild-G-3, SA-RWild-G-5), which would enhance visitor experience by promoting primitive settings and solitude.

Because alternative C recommends 13 new wilderness areas, it could restrain management activities and uses on 91,757 acres (such vegetation restoration and motorized recreation), as compared to no recommended wildernesses in alternative A. Combined with the 156,374 acres of designated wilderness, there would be restraints on management activities on 248,131 acres, which is about 13 percent of the forest. Not all recommended wildernesses are in need of restoration due to cliffs, talus slopes, existing condition of vegetation, or other elements of topography. However, some areas that would benefit from treatment such as fuels reduction would not be treated. This could result in a buildup of fuels and lead to a higher risk of uncharacteristic fire in frequent fire ERUs. Uncharacteristic fire could degrade wilderness characteristics. Motorized recreators would be displaced to other parts of the forest, which could increase impacts such as vegetation and soil loss in those areas.

The Coconino National Forest Travel Management Decision also indicates that motorized big game retrieval for elk is allowed in the recommended wilderness areas except for Strawberry Crater, East Clear Creek, and Barbershop. The areas that allow motorized big game retrieval would include almost all of Abineau (100 percent), Railroad Draw (100 percent), Cedar Bench (98 percent), and Black Mountain (95 percent), Walker (65 percent), Davey's (89 percent), Tin Can (76 percent), and Cimarron-Boulder (87 percent). In Black Mountain, Cedar Bench, Tin Can and Cimarron-Boulder, harvest levels are low and so motorized big game retrieval would only incidentally impact wilderness characteristics and, under most circumstances, would not lead to long-term impacts. Abineau and Railroad Draw are found in game units with higher harvest levels but are geographically small, so it is uncertain how much game would be retrieved within these areas as opposed to the rest of the unit. Thirty-six percent of Hackberry would permit motorized big game retrieval, but the vast majority of this area is inaccessible by vehicle because of terrain, so the effect would be minimal. Ninety-two percent of Deadwood Draw would allow elk game retrieval using motorized vehicles. See the Wilderness Area Evaluation Report (USDA Forest Service 2016e) for more information and a more in-depth discussion of the effects of wilderness and non-wilderness recommendations for each area.

Alternative D

Alternative D contains no new recommended wilderness areas. Therefore, the environmental consequences associated with designated wilderness and wild and scenic rivers in alternative D would be the same as those found in alternative B (modified). However, like alternative A, alternative D includes no recommended wilderness. Accordingly, alternative D is similar to alternative A in the manner that it addresses the demand for wilderness areas and their associated primitive, undeveloped settings, as well as the addition of new prohibitions or geographic restraints on management activities and uses. Alternative

D would still contain direction on how to manage recommended wilderness in case there is a future recommendation.

Inventoried Roadless Areas

Affected Environment

There are eight inventoried roadless areas totaling approximately 50,000 acres on the Coconino NF (table 50). Inventoried roadless areas and effects to roadless character were considered in developing the ROS classifications and all of these areas were considered in the Wilderness Area Evaluation Report (USDA Forest Service 2016e).

Table 50. Inventoried roadless areas on the Coconino NF

Name	Acres	Name	Acres
Barbershop Canyon	1,310	Jacks Canyon	2,856
Boulder Canyon	4,550	Lower Jacks Canyon	776
Cimarron Hills	5,300	Padre Canyon	9,424
East Clear Creek	2,004	Walker Mountain	6,378
Hackberry	17,873		

Environmental Consequences

Common to All Alternatives

There would be no negative effect to the roadless character of inventoried roadless areas on the forest from these alternatives. All of these areas have a recreation opportunity setting of semi-primitive non-motorized (SPNM) or semi-primitive motorized (SPM). Management in these areas would continue to follow national Forest Service policy that requires preservation of the roadless character of these areas and places strict restrictions and guidelines on road construction and tree cutting in these areas.

There would be no negative recreation effect to the roadless character of inventoried roadless areas on the forest from the alternatives. In alternative B (modified) and alternative D, all of these inventoried roadless areas are SPNM and in alternative C, Hackberry, Cimarron, Boulder, Barbershop and East Clear Creek Inventoried Roadless Areas are Primitive, because they are recommended for wilderness designation, and the rest are SPNM. Alternatives B (modified), C, and D have a standard that requires projects and management activities (SA-IRA-S-1). The 2000 Roadless Rule would impose direction on projects and management activities pursued under alternative A. Accordingly, the roadless character of these areas would be equally protected under all alternatives. All alternatives would limit not only road building (the 2000 Roadless Rule restriction), but motorized trails as well.

Alternative C

Inventoried roadless areas that are recommended for wilderness would also be managed under the plan guidance for recommended wilderness, which manages the areas to retain their primitive and undeveloped character (SA-RWild-DC-1). Plan guidance for recommended wilderness would also limit motorized vehicle activity to administrative use and visitor use permitted per the motor vehicle use map (SA-RWild-G-3), such as for motorized big game retrieval, until these areas are congressionally designated and added to the National Wilderness System. This would retain the roadless character of the areas. See the “Wilderness and Wild and Scenic Rivers” section for a description of the effects of alternative C on recommended wilderness areas.

National Trails and Scenic Roads

Affected Environment

Arizona National Scenic Trail, General Crook National Recreation Trail, and Wilson Mountain National Recreation Trail are the three national trails on the forest. The Arizona National Scenic Trail runs the length of the forest from the Mogollon Rim to the north end of the Flagstaff district. The General Crook National Recreation Trail follows the historic military route from Fort Apache to Camp Verde and is a national historic study trail (see the "Heritage Resources" section for more information). Wilson Mountain is a trail that overlooks scenic red rock country. Many of the views around Wilson Mountain Trail have been altered by evidence of the Brinns Fire in 2006. No new national trails are proposed by the plan alternatives.

The term "scenic road" is a general term to describe federally or State-designated scenic roads. Several roads in the Coconino NF have special designations because of their scenic qualities, historical contributions, or other unique factors. Designations include All-American Roads and State-designated Scenic Roads. The Historic Route 66 All-American Road and Red Rock All-American Road are the two nationally designated scenic byways on the Coconino NF. The forest has only a small segment of Historic Route 66 and no trailheads or developed facilities on it, because it is collocated with I-40 for most of its route through the forest. There are three trailheads and an observation site on the Red Rock All-American Road, the majority of which is within the Coconino NF boundaries. No new national scenic byways are proposed by the forest plan alternatives.

There are four Arizona Scenic roads on the Coconino NF: Dry Creek Scenic Road, Historic Route 66 (Ashfork to Lupton), San Francisco Peaks Scenic Road, and Sedona-Oak Creek Scenic Road. The Dry Creek Scenic Road is located on State Route 89A between milepost 363.5 and milepost 370. Associated points of interest include Red Rock State Park and Page Springs Hatchery. Historic Route 66 shares its Federal designation (All-American Road) with a State designation (Historic). There are short segments of the official scenic road crossing the Coconino NF and many parallel routes to Interstate 40 that were formerly part of the "Mother Road." The San Francisco Peaks Scenic Road follows US Highway 180 north of Flagstaff around the west side of the San Francisco Peaks, between milepost 224.0 and milepost 255.0. Associated points of interest include Museum of Northern Arizona, Hart Prairie Road, SnowBowl Ski Area, Lava River Cave and the Nordic Center. The Sedona-Oak Creek Canyon Scenic Road follows State Route 89A south of Flagstaff to Sedona, AZ, through Oak Creek Canyon between milepost 375.5 and milepost 390.0. Associated points of interest include Oak Creek Vista, Grasshopper Point, Slide Rock State Park, and Red Rock-Secret Mountain Wilderness. All of these roads offer scenic driving experiences.

Environmental Consequences

Common to All Alternatives

In alternative A, the General Crook National Recreation Trail has restrictions on motor vehicle use (except snowmobiles) and designates a 200-foot corridor to preserve evidence of the historic roadway and its landscape character (1987 Plan, pages 55 to 56). This direction would not limit vegetation treatments so long as their outcomes preserve the landscape character, except that rocks and trees that are historic trail markers would not be moved or damaged by the activities. This corridor would preserve most of the evidence associated with the historic features of the trail but not all. Other features outside the 200-foot corridor would be preserved under the National Historic Preservation Act of 1966 (P.L. 89-655). The restriction on motorized vehicles would not apply to the portions of the trail that are collocated with NFS Road 300 (Rim Road), but it would prevent single-track motor vehicle users form driving off of the road and onto the trail where it is not collocated with an existing road.

Under alternatives B (modified), C, and D, the General Crook National Recreation Trail has very similar direction to alternative A. Because of the "Coconino National Forest Travel Management Decision" (USDA Forest Service 2011g), it was not necessary to carry forward motorized vehicle prohibitions, and the desired condition of a non-motorized trail that emphasizes foot and horse travel (SA-NatlTrails-DC-6) was retained. Scenery and views, as well as the integrity of cultural and natural resources are carried forward as well (SA-NatlTrails-DC-1 and 2) with language that would apply to any national trail. Under alternative A, the historic character of the trail would be adequately protected from motorized vehicle use, except for where it co-occurs with a road (1987 Plan, page 55).

The General Crook National Recreation Trail was proposed as a national historic trail in the past, but no Congressional action has been taken on this proposal. Alternative A has management direction (1987 Plan, pages 55 to 57) and alternatives B (modified), C and D have a management approach (SA-NatlTrails-MgtApp) for collaborative protection and management of historic resources in the event of designation as a national historic trail.

Alternative A

There is direction in the 1987 plan to finalize a corridor for the Arizona National Scenic Trail that allows for a wide range of non-motorized uses and extends from the Mogollon Rim to the north end of the Flagstaff district (1987 Plan, page 52). This has been accomplished and the trail has been designated a national scenic trail. It also states that the forest should seek to designate the Wilson Mountain National Recreation Trail (1987 Plan, page 52), which has also been accomplished and provides no other direction for its management aside from forestwide wilderness direction.

Scenic byways are not addressed in the 1987 plan. The visual quality objectives for these areas, however, are set to protect the scenic resources along the byway (see "Scenic Resources" section for details). This lack of direction would allow inconsistent interpretation and character of the byways, which would result in projects being implemented that do not complement the unique sense of place promoted on these byways. As a result, the forest would not contribute as much as it could to these community efforts, which have an important economic impact on tourism related sectors.

Alternative B (modified)

In alternative B (modified), all national trails have desired conditions that help retain the values for which they were designated (SA-NatlTrails-DC-1, 2, 3, 4). The desired conditions promote less development in more remote areas of the trail, and the potential for more development near towns and developed recreation facilities (SA-NatlTrails-DC-3, 4). The desired conditions also emphasize the importance of making parts of the trail accessible through connector trails and signs to assist in wayfinding for visitors near towns and developed recreation sites (SA-NatlTrails-DC-4, 5, 7). These outcomes would encourage recreation use on the trail and assist long distance users. This alternative also has more comprehensive direction than in alternative A related to retention of the scenic quality of a national scenic trail (SA-NatlTrails-G-2, 3, 4, 9). The guidelines that focus on the Arizona National Scenic Trail (SA-NatlTrails-G-6, 7, 8, 9) would prevent utility lines and new roads and motorized trails from being built across or adjacent to the trail. Exceptions would occur where avoiding the trail is impossible or where crossing the trail would be a greater benefit to preserving the non-motorized setting than routing it nearby. This would concentrate access to the east side of Anderson Mesa to the existing roads and concentrate aboveground utilities along existing corridors. According to another guideline (SA-NatlTrails-G-3), recreation settings within a half mile of the trail should not be changed to a more developed setting. This would retain the more undeveloped ROS settings on the landscape along the trail corridor, and it would make it more difficult to construct new developed facilities or make long term special use commitments that are inconsistent with the current recreation setting in this area. A comprehensive trail management plan is being developed that provides additional direction and is incorporated by reference in alternative B (modified).

The Wilson Mountain National Recreation Trail and its recreation setting would be protected by an ROS of SPNM and a high scenic integrity objective. The wilderness opportunity spectrum objective for the portion of the trail in the Red Rock-Secret Mountain Wilderness is wilderness transition, which allows for a higher encounter level than is typical for wilderness without compromising the wilderness setting. Under alternative A, the direction for the trail had not been updated since its designation and, therefore, it did not take into account the increased visibility and interest of the trail. As a result, alternative B (modified) would allow for the setting and level of recreation to be more compatible with the objectives for the trail.

A guideline in the National Trails section directs the relocation of the Arizona National Scenic Trail whenever the trail alignment is established on a road or former road prism to promote a non-motorized setting (SA-NatlTrails-G-7). A management approach in the National Trails section encourages relocating any national trail that is on an open designated road or converting closed roads to trails (SA-NatlTrails-MgtApp). This would allow the forest to consider modifying routes to improve the user experience of hiking the trail rather than sharing it with vehicles.

In alternative B (modified), scenic roads have their own unique desired conditions (SA-ScenicRds-DC-1, 2, 3, 4), guidelines (SA-ScenicRds-G-1, 2, 3), and management approach (SA-ScenicRds-MgtApp). Established corridor management plans for federally and State-designated scenic roads are incorporated by reference (SA-ScenicRds-G-3). While the State-designated scenic roads are not administered by the Forest Service, scenic roads components would help to preserve and promote the routes for their intrinsic qualities (SA-ScenicRds-DC-1), ensure consistency with other jurisdictions (SA-ScenicRds-G-2, 3), and encourage Federal managers to work closely with Federal Highways and Arizona Department of Transportation and interested parties as opportunities arise to improve services and interpretive opportunities.

For the Historic Route 66 All-American Road, this alternative recognizes that the signage and facilities would be inconsistent with the natural setting in some places and more closely related to the cultural setting and social values associated with the route (SA-ScenicRds-G-3). There are currently no interpretive facilities or trailheads provided on the Coconino NF for Historic Route 66 visitors except for the Flagstaff Ranger District Office. Alternative B (modified) directs the forest to provide such facilities and to protect historic alignments of the route that might be interpreted for visitors (SA-ScenicRds-DC-2, SA-ScenicRds-G-2), which would increase the visibility of the forest's contribution to the byway and provide for education on the byway and the adjacent natural and historic resources. For the Red Rock All-American Road, the incorporation of amendment 12 carries forward the majority of the protections associated with the byway. A desired condition and guideline (SA-ScenicRds-DC-3, SA-ScenicRds-G-3) that apply to the road provide for safe multi-modal travel, wildlife crossings, and alternative transportation as discussed in the corridor management plan. These desired conditions would preserve the character of the road in such a way that the adjacent ROS settings would also be protected. The connectivity for wildlife and non-motorized recreation along and around the road is a key part of protecting its scenic values.

Alternative C

The environmental consequences associated with national trails and scenic byways in alternative C are the same as those disclosed in alternative B (modified).

Alternative D

The environmental consequences associated with national trails and scenic byways in alternative D are the same as those disclosed in alternative B (modified).

Research Natural Areas and Botanical and Geological Areas

Affected Environment

Research Natural Areas

Research natural areas (RNAs) are part of a national network of ecological areas designated in perpetuity for research and education and/or to maintain biological diversity on National Forest System lands. RNAs are principally for non-manipulative research, observation, and study. Any RNAs within existing wilderness are managed in accordance with agency policy on retaining wilderness characteristics.

There are four existing RNAs on the Coconino NF: Casner Canyon, G.A. Pearson, Oak Creek, and San Francisco Peaks. The 609-acre Casner Canyon RNA is north of Schnebly Hill Road and is noted for the Arizona cypress, which is in an almost pristine condition on the areas's lower slopes. The 150-acre G.A. Pearson RNA is within the Fort Valley Experimental Forest and, therefore, is not managed by this plan. The 1,853-acre Oak Creek RNA is in the West Fork of Oak Creek within the Red Rock-Secret Mountain Wilderness. The Oak Creek RNA is an example of a biologically diverse creekside area and is a paleobotanical area containing plant species surviving from the last ice age. The 1,010-acre San Francisco Peaks RNA is within the Kachina Peaks Wilderness. The San Francisco Peaks RNA preserves the characteristics of the transition zone between mixed conifer and alpine tundra with populations of bristlecone pine.

Botanical and Geological Areas

Botanical and geological areas are designated for a special feature such as a rare plant community or exemplary geological formation. There are four existing botanical areas and two existing geological areas.

The Coconino NF has four existing botanical areas: Verde Valley, Mogollon Rim, Fossil Springs, and Fern Mountain. These special designations provide unique natural resources for research and education. The 1,209-acre Verde Valley Botanical Area preserves a unique, limestone-dependent desert community containing the federally endangered Arizona cliffrose and an assemblage of other endemic plants. The 339-acre Mogollon Rim Botanical Area preserves a representative portion of a white fir/bigtooth maple community. This community represents a unique vegetation community in Arizona and is found only at a few locations along the Mogollon Rim. The 12-acre Fossil Springs Botanical Area preserves a riparian deciduous forest associated with a large perennial spring and travertine geology. The 186-acre Fern Mountain Botanical Area preserves a unique high-elevation riparian scrub community dominated by Bebb's willow. This is one of the southernmost extents of this community.

Red Mountain Geological Area is an unusual volcanic cinder cone located in the northwestern corner of the forest within the San Francisco Volcanic Field. The 1,201-acre Red Mountain Geological Area preserves the exposed and eroded internal structure of a symmetrical cinder cone within the San Francisco Peaks volcanic field. It is not the typical cone-shaped volcano with a lava flow that ensued from the base of the cone. On the northeast side of the cinder cone is the "amphitheater," which may have been blasted away by steam explosions resulting from a reaction of groundwater along a regional fault and hot rock from subsurface magmatic activity. Red Mountain shows the internal structure of the cinder cone and scientists have conducted extensive research in interpreting its complex history and geologic features (Priest et al. 2002, Riggs and Duffield 2008).

The Red Mountain Geologic Area was first proposed as a special area in 1977, and had a withdrawal from mineral entry at that time. The mineral withdrawal has since expired. The process for renewing the mineral withdrawal was started again in 2003; however, the mineral segregation expired in 2005. Under the "Coconino National Forest Travel Management Decision (USDA Forest Service 2011g), off-road

driving and motorized big game retrieval are prohibited in this special area. Part of the Red Mountain Geologic Area is open to grazing (93 acres). Roads are managed next to the geologic area to prevent vehicle intrusion in order to maintain the natural conditions and processes. Roads that entered the geologic area were blocked by fencing and/or obliterated under the 1987 plan, and many of the roads surrounding the geological area have been decommissioned.

Environmental Consequences

Common to All Alternatives

For the effects of research natural areas and geological and botanical area designation on wildlife, see the "Wildlife, Fish, and Plants" section, particularly Bebb's willow, Arizona cliffrose, San Francisco ragwort, Chiricahua leopard frog, northern goshawk, and pronghorn (management indicator species).

Existing management areas, such as the Verde Valley Botanical Area, San Francisco Peaks Research Natural Area, and Fern Mountain Botanical Area, as well as the recovery plans for San Francisco Peaks ragwort and Arizona cliffrose, conservation agreement for Arizona Bugbane, Flagstaff Pennyroyal Habitat Management Plan, and the Alpine Tundra Management Plan provide for management and guidance for these and other rare endemic plants. Relevant laws, regulations, and policies, such as direction in Forest Service Manual 2600, which regulate the management of threatened, endangered, and sensitive plants would remain in place.

Alternative A

The 1987 plan identified one geological area, four botanical areas, and four established and three recommended research natural areas. All but one[38] of these areas are managed under Management Area 17, which provides direction to prohibit off-road driving and emphasizes the need to set carrying capacities and limit visitation to preserve the characteristic resources of the areas (1987 Plan, pages 194, 196-1).

In the Casner and Oak Creek Research Natural Areas, there are additional restrictions on recreation campfires and overnight camping (1987 Plan, page 196-1). This direction would continue to manage these areas for non-motorized day-use recreation in a very limited amount. The San Francisco Peaks Research Natural Area provides for management and guidance for rare endemic plants (1987 Plan, page 101).

The three recommended research natural areas, West Clear Creek (769 acres), Rocky Gulch (926 acres), and an expansion of the existing San Francisco Peaks Research Natural Area (141 acres for eastside and 145 acres for westside), were never established, but have been managed as if they were established since the 1987 plan was implemented. The proposed West Clear Creek Research Natural Area is an example of riparian communities associated with hanging gardens and springs in a steep canyon setting. The proposed Rocky Gulch Research Natural Area is an example of old growth ponderosa pine, and it is a control for research in the Beaver Creek watershed. The141-acre proposed expansion to the east of the San Francisco Peaks Research Natural Area is an example of alpine tundra, a rare feature in the Southwestern Region. The The145-acre proposed expansion to the west of the San Francisco Peaks Research Natural Area contains bristlecone pine. The forest would continue to propose these research natural areas. Because recreation has negatively impacted the resources in the original location of the West Clear Creek Research Natural Area, the forest would need to implement a management strategy to minimize the effects of recreation in the riparian area if alternative A is selected. This would possibly

[38] The GA Pearson Research Natural Area is within the Fort Valley Experimental Forest and as such, outside of the Coconino NF's authority to manage.

limit the amount and type of recreation that can occur there, which would change the character of visitors' wilderness experience in the West Clear Creek Wilderness.

Botanical areas would continue to follow the guidance outlined in 1987 plan, mostly guidance from Management Area 17 and from Forest Service Manual direction. This guidance includes restrictions on off-road motorized travel that is redundant with the forest travel management decision (USDA Forest Service 2011g) and direction for new utility corridors to avoid research natural areas and botanical and geological areas, which is carried forward under all alternatives (1987 Plan, pages 195 to 196). Alternative A does not address many of the unique features or threats to the botanical areas. The Verde Valley and Fern Mountain Botanical Areas would provide for management and guidance for rare endemic plants (1987 Plan, pages 193 to 194). No new botanical areas would be proposed.

The consequences of implementing this alternative for geological resources are that the Red Mountain Geological Area is the only geological area, and it would be managed to maintain, as nearly as possible, existing conditions and natural processes for public enjoyment, demonstration, and study (1987 Plan, pages 193 to 194). Interpretative and education demonstration opportunities would be emphasized and enhanced through selective facility development (1987 Plan, page 194). Natural events would not be rehabilitated to preserve the natural processes of the area (1987 Plan, page 194). Grazing would be allowed in this special area where lands have capacity; this would protect the unique geological features from increased erosion caused by cattle passing through the area (1987 Plan, page 195). Visual quality objectives of retention and partial retention would prevent activities that would alter the physical appearance or dominate the landscape for the geological area (1987 Plan, page 194).

Alternative A does not have a recreation opportunity setting that protects the setting of the Red Mountain Geological Area from motorized recreation or development. It is classified as roaded natural. Even though this is a special area that, according to the FSM 2370, should have minimal development, there is not sufficient protection in the 1987 plan for the recreation setting provided by its designation. The development of a motorized trail or road is still possible under alternative A because of the ROS and because the concept of "minimal development" can be broadly interpreted. On the other hand, alternative A has language that supports the natural setting and geological features of the area (1987 Plan, pages 193 to 194) and currently, off-road driving is prohibited by a closure order and the forest travel management decision (USDA Forest Service 2011g)—thereby, preserving the natural conditions. This contradictory direction has the potential to create confusion during implementation, and plan language does not adequately protect the resources for which the area is designated.

The Red Mountain Geological Area would be managed to promote conservation of its interpretative, scientific, and aesthetic values. The lack of roads open to the public within the areas and the closure to off-road driving would protect the soils, geology, botanical, and ecological resources of the area. Other unique geological areas or features on the forest would not have this degree or level of conservation and would not be designated as special areas.

Roads adjacent to the Red Mountain Geological Area are managed to prohibit vehicle intrusion. Under this alternative, the existing mineral withdrawal, even though it has lapsed, would be maintained as long as it was consistent with the management plan of that area and approved by the forest supervisor.

Alternative A is also silent about allowing mechanized travel on designated trails within these special areas. Some conflicts have been observed, especially along the Lime Kiln Trail (an historic road but converted to non-motorized use). Bicycle use on the trail has contributed to widening of the trail prism in some locations; thus, impacting the soil and crushing some cliffrose plants.

Alternative B (modified)

Alternative B (modified) proposes (or re-proposes) the proposed research natural areas listed in alternative A, with some modifications. The proposed West Clear Creek Research Natural Area would be located a little farther up the canyon and would be a little larger (1,007 acres).The proposed San Francisco Peaks Research Natural Area expansion would only include the 141-acre parcel on the eastern side of the existing RNA. The proposed Rocky Gulch Research Natural Area is the same 926-acre area as alternative A. This alternative has greater recreation restrictions in research natural areas than alternative A (SA-RNABotGeo-DC-1, 2, 4, SA-RNABotGeo-O-1, SA-RNABotGeo-S-1, 2, SA-RNABotGeo-G-5, 6). The more specific restrictions for Casner and Oak Creek Research Natural Areas would be applied to all research natural areas and would restrict overnight camping and campfires in these areas. Commercial tours would also be restricted except in support of research in the remaining established research natural areas. This would result in a greater protection of the unique species and the resource purpose of the area, and it would be more consistent with Forest Service policy. It would also decrease recreation opportunities in these areas. For the two research natural areas (one established and one proposed) in wilderness, recreation use would continue to occur but would be in a more managed setting consistent with a transition or a semi-primitive wilderness opportunity spectrum, where signs and evidence of management would be present, but subordinate to the wilderness characteristics.

Alternative B (modified) carries forward the Red Mountain Geological Area and proposes a 763-acre Cottonwood Basin Botanical and Geological Area to preserve the unique rock formations and botanical diversity within these areas. This alternative has guidelines (SA-RNABotGeo-G-3, 4, 7, 8, 9) that provide a broad framework for minimizing impacts from recreational uses, wildfire management and suppression actions, and grazing management. In both geological areas, protection of the specific geological features and characteristics of these areas is emphasized in the desired conditions statements and standards (SA-RNABotGeo-DC-1, 2, SA-RNABotGeo-S-1, 2). In addition, in Cottonwood Basin, the botanical features associated with the geologic tuff are also addressed in desired conditions and guidelines (SA-RNABotGeo-DC-5, 6, SA-RNABotGeo-G-7, 8, 9). Forest Service administrative use, public recreation, and research activities generally would not disturb or alter the conditions of the areas per plan direction. Volcanic slopes in the Red Mountain and Cottonwood Basin areas would be left undisturbed so that management actions or human activities would not accelerate natural erosion processes.

Rock removal would be limited to scientific purposes, which would prevent mining and personal collection under special use permit. There would also be limited recreational rock hounding for personal use in these areas (SA-RNABotGeo-G-8). This guideline (SA-RNABotGeo-G-8) would limit rock collection in geological areas to approved scientific purposes conducted under the appropriate authorization. This limitation would allow violators to be cited and, as a result, would deter removal of rock landform, theft which degrades the unique character and aesthetic quality of these geological areas. Interpretative brochures or information would emphasize conservation and protection of the geological resource as a means of education about this guideline (SA-RNABotGeo-DC-6). Additionally, partnerships with site stewards would assist with interpretation and monitoring for both the Cottonwood Basin and Red Mountain Geological Areas. The desired condition for both areas seeks to reduce the evidence of human impacts to these areas, so increased vandalism or trash may lead to further restrictions on recreational use of these areas through closures or to increased monitoring and education at the site.

Recreational uses such as road use, camping, and hiking and biking on trails are a disturbance to natural setting of the geological and botanical areas and have consequences of localizing and concentrating disturbances to the landforms, soils, and plants. These disturbances could alter the slope stability of the areas, change surface hydrology of the slopes, and destroy natural vegetation protecting slopes from erosion. The line officer has various options to relieve impacts which include but are not limited to: administrative actions such as area closures, road closure or decommissioning, or various recreational use

restrictions. Any proposed new recreational uses such as trail development for single or multiple user types (e.g., hiking, horseback riding) would be similarly evaluated.

Alternative B (modified) proposes a new 763-acre area in Cottonwood Basin as a combined botanical area (185 acres) and geological area (578 acres). The geological portion of this new area contains distinct, unique, visually attractive, and interesting geologic formations called fumeroles that have developed from physical and chemical weathering of volcanic fumeroles that formed within the Towel Creek Tuff. Fumeroles are cracks or vents in the Earth's surface through which steam and volcanic gases escape into the environment. The formations resemble tepees or cones with holes or caverns in the rock formed by weathering processes. The tepees themselves are mostly unvegetated and form a dramatic contrast to the valley bottom area, which has a variety of grass, shrub, cactus, and flower species. The geological portion of this new area also includes habitat for some of the unique native plant community in the area.

The botanical portion of this new area includes springs and soils that contribute to the unique plant community's diversity. Although no threatened, endangered, or sensitive plant species or analysis species have yet been collected in the area, the botanical diversity of the area is three times greater than grasslands typically found within this ERU. The geological-botanical area, proposed under alternative B (modified) contains unique compositions of rocky shallow soils that were formed by a combination of lakebed sediments and volcanic activity, which are the focus of the geological area and are able to support this unique plant community. Most of this special area overlaps the Hackberry recommended wilderness.

Two roads within the Cottonwood Basin Geological and Botanical Area provide motorized recreational access to the area. Alternative B (modified) proposes that such roads would not be suitable in a geological area (SA-RNABotGeo-DC-5, SA-RNABotGeo-G-7). Forest System Roads 500 and 708 would define a partial boundary for the geological area and provide access or viewing and hiking. The segments of these roads that are within the subwatershed are accelerating erosion and loss of vegetative cover, thereby disturbing the natural integrity of the soils and landforms. This disturbance is also inconsistent with desired conditions, which indicate that there is no evidence of vandalism, trash dumping, or human alteration of the landforms (SA-RNABotGeo-DC-5, FW-Rec-All-DC-5). As a result, continued use of these roads would require improved maintenance or closure to meet the geological area's desired conditions. Likewise, camping corridors and other recreational uses would need to be excluded where these uses have a negative impact on the resource for which the area is designated.

In the Red Mountain Geological Area and proposed Cottonwood Basin Geological and Botanical Area, non-motorized recreation would be allowed to access the areas and to view them (SA-RNABotGeo-G-7, 9). There are no known existing trail systems (foot or bicycle) in either of these areas. Foot travel as the main means of access would have the fewest consequences to the integrity of landforms and soils. Horseback riding would also be permitted, but would be anticipated to occur at lower levels because of the size of the area. Given these desired conditions, it would be unlikely that trailheads or parking lot access in these areas would be designed to accommodate horse trailers. There are no existing designated trails within the proposed Cottonwood Basin Geological and Botanical Area, and all hiking is dispersed. Recognizing that at low levels of use, dispersed hiking may be beneficial to the resource over more concentrated trails, alternative B (modified) does not impose the need for a trail system. It also does not prevent trails from being developed if it supports maintaining desired conditions.

Under alternative B (modified), mechanized recreation (e.g., bicycles) is not suitable in existing and proposed botanical and geological areas unless on designated trails where this use is permitted. See chapter 4 in the Plan for suitability determinations. Any mechanized access would have to meet the desired conditions and guidelines for these areas. Consequently mountain biking would not be allowed, and new bicycle trails would not be constructed in these areas. Bicycle use on the Lime Kiln trail has contributed to impacts on Arizona cliffrose and other plants. The removal of bicycling as a permissible

activity in alternative B (modified) would reduce the current conflicts within botanical areas (e.g., widening of existing trails and establishment of social trails) and would eliminate associated threats to Arizona cliffrose from mechanized use. Some of these areas are very desirable recreation locations for mountain biking, and these users would be displaced elsewhere or would need rerouted trails. In particular, this would affect the two trails within the Verde Valley Botanical Area. The historic Lime Kiln Trail, which is accessible from Dead Horse Ranch State Park and travels 15.2 miles northeast, would have mechanized restrictions for 1.1 miles (7 percent) while traveling through the Verde Valley Botanical Area. On the eastern portion of the botanical area, the 1.8-mile Bill Ensing Trail would have 1.4 miles (78 percent) phased out to mechanized use. Overall, this would not substantially decrease mountain biking opportunities on the forest, because these areas are relatively small and would not likely be the first place new trails would be developed, given their focus on conservation of the botanical and geological resources. It also would reduce soil disturbance and damage to plants such as crushing, widening of the trail outside of the trail prism, and erosion within the botanical areas.

Within alternative B (modified), wildfires would be used to achieve resource improvements consistent with the ecology of the area, and suppression tactics would be used that are protective of resources. Geological areas that have evolved with wildfire would not be impacted by processes and effects associated with wildfire. Appropriate suppression techniques would ensure the overall maintenance of landform stability and the unique vegetative communities associated with these areas.

Livestock grazing can impact the soils, vegetation, and underlying bedrock formations via plant grazing and trampling. Alternative B (modified) includes a guideline for grazing allotment management plans to include provisions that protect the uniqueness and/or ecological condition of these special areas (SA-RNABotGeo-G-4). Allotments that use adaptive management would consider the impacts of grazing on the desired conditions for the geological and botanical areas and adjust grazing management accordingly to protect their unique ecological values, functions, and processes. As a result, livestock grazing would not impact the geological formation.

Alternative B (modified) includes direction to manage levels of access to protect the uniqueness and/or ecological condition of these special areas, and the values for which they were designated, established, or proposed (SA-RNABotGeo-DC-5). Forestwide direction for soils requires specific design features for projects on soils that are sensitive to degradation when disturbed, such as calcareous soils. As a result, Arizona cliffrose and other disturbance-sensitive plants in these areas would be better protected than under alternative A, which only limits off-road driving in the special areas included in Management Area 17.

Alternative C

The environmental consequences associated with research natural areas and botanical and geological areas in alternative C are similar to those found in alternative B (modified).

Alternative D

Alternative D is similar to alternative B (modified) except that unlike alternatives B (modified) and C, which propose the Cottonwood Basin Geological and Botanical Area (763 acres), alternative D only proposes the Cottonwood Basin Geological Area (185 acres). The impacts associated with the proposal of the Cottonwood Basin Geological Area would be the same as those disclosed under alternative B (modified) for the proposed Cottonwood Basin Geological and Botanical Area except the impacts would only apply to the 185-acre geological area.

Environmental Study Areas

Affected Environment

Environmental study areas are areas set aside for educational opportunities for public schools, youth organizations, and the general public, which typically have an approved school curriculum that accompanies their designations. There are three identified environmental study areas on the Coconino NF in the Flagstaff area: Griffith Springs (321 acres), Mount Elden (495 acres), and Old Caves Crater (761 acres).

Environmental Consequences

Common to All Alternatives

Environmental study areas have restrictions on new or expanded special use authorizations (1987 Plan, page 79, MA-MtElden-G-5), livestock grazing (1987 Plan, page 199), camping (Elden only) (1987 Plan, page 199, MA-MtElden-DC-7), and off-road driving. In addition, the Mount Elden Environmental Study Area is only open to foot traffic, although horses are allowed on the El Paso natural gas pipeline trail (1987 Plan, page 90; MA-MtElden-DC-7). Except for horse traffic on the El Paso natural gas pipeline, none of these activities are currently occurring in these environmental study areas. These restrictions would have the effect of limiting opportunities for new special use authorizations, livestock grazing, camping, horse riding, mechanized transportation, and off-road driving on some or all of these areas (up to 1,577 acres). On the other hand, these restrictions would protect the purpose of these areas to provide educational opportunities for classrooms in the outdoors. One effect of these restrictions in these areas is that they would continue to support the local public schools and an informed youth in the Flagstaff area. Another effect of these restrictions would be reduced human-related disturbance associated with special use authorizations, livestock grazing, camping, and off-road driving which would allow for more natural conditions in these areas and the maintenance or improvement toward desired conditions.

Cumulative Effects

Cumulative consequences are those consequences of foreseeable activities on lands of other ownership that, in conjunction with management activities likely to occur on the Coconino NF, may intensify, negate, improve, or otherwise affect the vegetation types, habitats, and species resources of the forest. The analysis area for cumulative effects includes the Coconino NF and adjacent lands in northern Arizona including the Kaibab, Prescott, Tonto and Apache –Sitgreaves NF, several local National Monuments, Arizona State Parks, Coconino and Yavapai County, local towns and cities and local parks.

The cumulative effects analysis timeframe for special areas is the next 10 to 15 years and the area is the same as for the recreation setting, developed and dispersed recreation, and recreation special uses.

Common to All Alternatives

The forests that neighbor the Coconino NF all have designated and recommended wilderness areas, designated and/or eligible wild and scenic rivers, and inventoried roadless areas that were identified in the 2001 Roadless Area Conservation Rule. The more restrictive management that is applied to these areas results in areas that are less developed and more primitive. The Kaibab NF manages and/or co-manages four designated wilderness areas totaling 116,249 acres and has four recommended wilderness areas totaling approximately 6,400 acres. The Kaibab NF also has 20 miles of eligible wild and scenic river and over 53,000 acres of inventoried roadless areas. The Prescott NF manages eight designated wilderness areas totaling 104,480 acres and has eight recommended wilderness areas totaling approximately 23,000 acres. The Prescott NF also has over 50 miles of designated and eligible wild and scenic river and over 139,000 acres of inventoried roadless areas. The Apache-Sitgreaves NF manages over 23,000 acres of designated wilderness and has over 7,000 acres of recommended wilderness. The Apache-Sitgreaves

NF also has 339 miles of eligible wild and scenic river and nearly 322,000 acres of inventoried roadless areas. The Tonto NF manages over 590,000 acres of designated wilderness. The Tonto NF also has nearly 37 miles of designated wild and scenic river and over 170,000 acres of inventoried roadless areas.

There is a high recreation demand for more primitive settings and these designated and recommended wilderness areas, wild and scenic rivers, and inventoried roadless areas would help address that demand. While these additional areas may not satisfy the overall demand for such areas over time, they will provide more options for primitive recreation near the Coconino NF, as well as protection for the species and natural resources within them. Increased options would allow users to disperse to a greater degree. This would allow these primitive settings to better provide solitude, challenge, risk, unmodified natural environments, and minimal encounters and/or signs of other users.

The Arizona National Scenic Trail is over 800 miles long, stretching from the United States border with Mexico to Utah. It crosses three other national forests (Coronado, Kaibab, and Tonto) as well as land administered by the Bureau of Land Management, the National Park Service, Arizona State Parks, and several counties and municipalities. A comprehensive management plan is being developed for the trail at this time. The Arizona Trail Comprehensive Management Plan will provide direction to improve protection of the national scenic trail, use partnerships to manage it, and promote appropriate recreational uses. This direction would provide consistent management across the entire scenic trail, which complement the portions of the scenic trail on the Coconino NF.

The Arizona Department of Transportation prepares community planning documents for scenic roads called Corridor Management Plans (CMP). CMPs look at entire scenic and/or historic routes and inventories and document the special qualities, characteristics, features, and resources of that byway. Several existing and pending CMPs cover routes that are within the boundaries of, and/or adjacent to, the Coconino NF. Some of these routes include, but are not limited to, the Sedona-Oak Creek Canyon Scenic Road (State Route 89A from milepost 375.5 to milepost 390.0), San Francisco Peaks Scenic Road (US Highway 180 from milepost 226 to milepost 255), Red Rock Scenic Road (State Route 179 from milepost 302.5 to milepost 310.0), and Historic Route 66. Management to preserve and protect these identified special qualities will be beneficial to the scenery on the Coconino NF.

Because the RNAs are located within the interior of the forests, activities occurring off-forests should have no or extremely limited impacts. Establishment of RNAs on the forests should contribute to the vegetation communities within the existing RNAs system and provide a potential scientific basis for climate change research. The forests' RNAs would also be complementary to those on the Apache-Sitgreaves, Gila, Coronado, and Tonto NFs, as well as those within the Bureau of Land Management.

Montezuma Castle, Walnut Canyon, and Sunset Crater Volcano National Monuments (National Park Service) include outstanding geological and botanical resources within and adjacent to the Coconino NF. Management plans include management direction to preserve, protect, and maintain geological formations and natural resources for scientific interests and research, and for public interest, including scenic, recreational, educational, social, and historic pursuits. With emphasis on preserving, protecting, and maintaining natural resources, it is anticipated that any cumulative consequences would promote protection of outstanding geological and botanical resources in the analysis area. This would increase the interpretative and educational opportunities that the forest can provide the public about the interrelationships between botany and geology. This would also provide for increased opportunities to develop partnerships with the scientific community, researchers, and conservationists interested in the areas, and it would expand the collective knowledge about the features and characteristics of the areas.

There would be no known cumulative environmental consequences to environmental study areas under all alternatives because there are no known foreseeable effects from activities on adjacent lands.

Scenic Resources

In addition to other natural resources, scenery[39] must be cared for and managed to maintain quality scenic resources for future generations. Scenic resources vary by location and by existing natural features including vegetation, water features, landform and geology, and human-made elements. All activities that forest visitors experience are performed in a scenic environment where scenery is defined by the arrangement of the natural elements of the landscape along with components of the built environment. Scenery combines all the ecological features and human elements; the composition of these attributes is what gives a landscape its character or image.

Currently, the scenic resources of the Coconino NF are managed using the visual management system that allocates visual quality objectives (VQOs) to NFS lands (USDA Forest Service 1977 and 1987). VQOs are a combined measurement of the scenic quality of the landscape of NFS lands and the public's level of concern for that scenic quality. The existing condition of scenic resources on the landscape is a result of implementing the 1987 plan and its accompanying visual management system.

Management of multiple resources has, to varying degrees, altered the natural landscape character. The most obvious effects on scenic resources are from vegetation and landform alterations. Resource management activities which have altered scenic resources over the short- and/or long-term include, but are not limited to: vegetation management, mineral extraction, roads and trails, campgrounds and picnic grounds, fire management (e.g., suppression and prescribed burning), and livestock grazing.

A need to update desired conditions and other plan components for scenery management where guidance is partial or absent in the 1987 plan was identified in the "Economic and Social Sustainability Assessment" (USDA Forest Service 2008a) and subsequent "Analysis of the Management Situation" (USDA Forest Service 2010a). As previously mentioned, guidance from the 1987 plan for scenic resources is provided by the visual management system, a system released in 1977 that has since been superseded by the scenery management system. For more information, see "Landscape Character Descriptions for the Coconino NF" (USDA Forest Service 2016l) and the "Scenery Management System Inventory Report" (USDA Forest Service 2015b) in the project record.

Under the visual management system, any human alterations that are not part of the characteristic landscape would be considered negative, even positive cultural features. Most human alterations, even when planned to improve ecosystem processes, would also be considered negative. The established duration of impact for VQOs in the visual management system handbook would be beneficial for enhancing or maintaining high scenic quality in retention and partial retention VQO areas.

Landscape character description is one of the components the scenery management system uses to determine if assigned scenic integrity objectives are being met. Environmental context for the scenery management system can be provided by measuring deviations from the existing landscape character, and ecosystems. With ecosystems providing the context, no specific duration of scenic impacts are assigned to a scenic integrity objective but, rather, the focus is on movement toward the desired landscape character (USDA Forest Service 1995, page 20). Although specific timeframes are not assigned in the scenery management system handbook, duration of impacts is always considered in site-specific project planning and analysis with the direct intent to provide high quality scenery and achieve the highest scenic integrity possible (USDA Forest Service 1995, pages 5 to 9). The scenery management system also recognizes positive cultural landscapes or cultural scenic attributes where some human alterations have become accepted over time to become expected images or valued features in the landscape contributing to high-

[39] The terms "scenery" and "scenic resources" are used interchangeably in this section.

quality scenery. The scenery management system also places emphasis on constituent analysis. Constituent analysis leads to a determination of the relative importance of aesthetics to the public.

Affected Environment

Landscapes of the Coconino NF have a wide variety of features providing for some of the most spectacular scenery in the Southwest. The approximately 2-million-acre Coconino NF is located in north-central Arizona and is at the southern end of the Colorado Plateau with elevations varying from 2,600 to 12,633 feet. Dramatic landforms dominate the landscape. Numerous cinder hills and volcanoes of the San Francisco Peaks volcanic field are scattered across the northern portion. The San Francisco Peaks, including the highest point in Arizona, tower over the flat, heavily timbered Colorado Plateau, which is home of the largest contiguous stand of ponderosa pine in the world. The colorful collection of buttes, pinnacles, mesas, and canyons surrounding Sedona is world famous for its red rock vistas. The remains of ancient wetlands, these crimson cliffs have been carved by the forces of the desert into one of nature's most magnificent masterpieces (USDA Forest Service 2016l). The Mogollon Rim, a high rocky 1,000-foot escarpment that runs for about 200 miles across central Arizona, delineates the southeastern border of the forest. Deep canyons and natural lakes are an important part of this forest's character. The Coconino NF's natural, cultural, and historic resources attract visitors, making it a regional, national, and international year-round recreation destination. One of the main attractions is the forest's natural beauty and opportunities to experience nature (USDA Forest Service 2010d). The activities seeing the greatest number of participants on the Coconino NF are hiking/walking, viewing natural features, relaxing, driving for pleasure, and visiting historic sites. Downhill skiing, bicycling, fishing, and viewing wildlife were also very popular primary activities (USDA Forest Service 2016n).

People are drawn to the diversity of settings provided which range from: warm grasslands in the Verde Valley, cool riparian respite in canyons, and prominent red rock spires and buttes around Sedona to Flagstaff's snow-covered peaks and forests. Visitors come to the Coconino NF for a cool escape from desert climates and city living and for its outstanding recreation opportunities such as hiking, viewing scenery, boating, fishing, horseback riding, river floating, winter sports, motorized recreation, and cabin and lookout rentals. Recreation experiences vary from crowded to uncrowded in open and undeveloped landscapes. The forest has 10 designated wilderness areas and many rugged canyons offering opportunities for solitude and back-country experiences. Numerous scenic drives wind through the forest, offering scenery viewing opportunities. The forest also has many prehistoric and historic ruins. American Indians and ranchers are a significant part of the forest history, and their traditional uses remain an important part of the cultural landscape of the Coconino NF.

The "Scenery Management System Inventory Report" (USDA Forest Service 2015b) describes the detailed process used to determine and rate existing scenic integrity for the Coconino NF. Existing scenic integrity indicates the degree of intactness and wholeness of the landscape character, or it can be thought of as a measure of the degree of visible disruption of landscape character. Disruptions in the landscape character most often come from human alterations to the landscape such as roads or vegetation management. Human alterations can sometimes raise or maintain integrity. More often scenic integrity is lowered, depending on the degree of deviation from the valued landscape character.

A landscape with very minimal visual disruption is considered to have high existing scenic integrity; while those landscapes with more visual disruptions or alterations are viewed as having lower existing scenic integrity. Existing scenic integrity is expressed and mapped in terms of very high, high, moderate, low, very low, and unacceptably low.

Table 51 presents a summary of the existing scenic integrity inventory for the forest and displays the acres in each existing scenic integrity level. A map of the forest's existing scenic integrity can be found in appendix A of this FEIS.

Environmental Consequences

All alternatives provide desired conditions, objectives, guidelines, and standards to manage scenic resources. The main difference among alternatives is the management system used (i.e., visual management system versus scenery management system) and whether that system manages scenic resources in the context of ecosystem management. Alternative A manages scenic resources using VQOs, developed from the 1987 visual management system inventories, that range from preservation to maximum modification. Alternatives B (modified), C, and D use the scenery management system, via scenic integrity objectives (SIOs), to manage scenic resources in the context of ecosystem management for every acre of NFS lands. SIOs vary from very high to low.

The existing landscape and consequent scenic integrity and landscape character on the forest could potentially be negatively or positively impacted by many naturally occurring and management-induced activities, including any of the following: mechanical vegetation treatments, cutting of understory vegetation, prescribed fires, wildfires, firefighting methodologies, livestock grazing, lands special uses, land adjustments, mineral/geothermal development, geothermal development, roads, recreation, and/or climate change. With the exception of the naturally occurring activities (e.g., wildfire, climate change), each alternative contains direction that guides where and how much of these types of activities may occur on the forest. In this discussion, uncharacteristic wildfires in fire-adapted ERUs are wildfires whose frequency, severity, and/or extent are substantially different from those to which a given ERU has evolved. For example, in ERUs that are adapted to frequent, low-severity fires, such as ponderosa pine and mixed conifer with frequent fire, then high severity fires over large areas would be considered uncharacteristic. Similarly, in ERUs adapted to high severity fires, such as spruce-fir, then low severity fires would be generally uncharacteristic, though they may be desirable under certain conditions, such as in wildland-urban interface. In ERUs like interior chaparral, very large high-severity burn patches would be uncharacteristic where historically, the burn patches were smaller. Wildfires in ERUs not adapted to fire like Alpine Tundra or Desert Communities ERUs would also be uncharacteristic. In most cases, wildfire in riparian areas would also be uncharacteristic.

Comparison of alternatives is based on the level of impact that each alternative's direction would have on scenic resources, both in moving those resources toward or away from the landscape character description for an area. Landscape character is not explicitly described in alternative A; however, alternative A has some scenery goals[40] and guidelines. Descriptions of the forest's landscape character for alternatives B (modified), C, and D are found in a separate document titled Landscape Character Descriptions, Coconino National Forest (USDA Forest Service 2016l). In alternatives B (modified), C, and D, desired scenic integrity objectives are found in the desired conditions for Scenic Resources. The applicable landscape character description is identified in the General Description and Background section for each management area.

[40] A scenery goal is a management prescription designed to maintain or modify the existing landscape character to a desired landscape character.

Table 51. Existing scenic integrity level acres

Existing Scenic Integrity Level	Acres	Percent of Forest	Coconino NF Landscape Examples
Very High Highest possible level of intactness with a primitive and natural sense of place.	237,623	13	Designated wilderness areas.
High Natural appearing; intact; deviations are not evident.	450,210	24	Semiprimitive nonmotorized ROS class or potential wilderness areas with medium or low capability[2].
Moderate Appears slightly altered due to transportation system, recreation developments, vegetation management, etc.	1,034,619	56	General forest areas without substantial alterations such as Verde Valley and Pine Belt Management Areas.
Low Visual disruptions may dominate the landscape.	75,355	4	Arizona Snowbowl (aerial view), Cinder Hills OHV area, some utility corridors, high burn severity portions of Brins Fire and Schultz Fire of 2010, and some insect/disease epidemic areas.
Very Low Alterations may strongly dominate the landscape.	48,414	3	Sites with unnatural-appearing shapes and edges and/or an extensive network of roads, such as utility corridors, gravel pits, and other surface mining activities, communications sites, and vegetation management activities.
Unacceptably Low[1] Extremely and very noticeably altered; rehabilitation needed.	341	0	The pumice mine pit located north of Flagstaff, Arizona.

Note: Acreage calculations only include NFS lands.

[1] The capability process identifies the presence of wilderness character: a medium capability area is mostly natural; however, there are effects to the natural environment, visible minor developments, remoteness and solitude in part of the area, and/or some management challenges if the area were designated as a wilderness; a low capability area has effects to naturalness such as non-native species that are present, persistent, and affect ecosystem function; has developments or common activities that are not consistent with wilderness, does not offer remoteness and solitude, and/or would be very difficult to manage as wilderness.

[2] This existing scenic integrity rating level is used only to assess and inventory current conditions and is never a scenic integrity objective or a desired condition.

Common to All Alternatives

There is potential to temporarily impact the existing landscape and scenic integrity from mechanical vegetation treatment activities under all alternatives. Vegetation management practices can directly affect scenery and the perception of scenic beauty (Ribe 1989). Activities including tree removal, depending on the intensity of the treatment, can have varying consequences on scenery. Mechanical treatments targeting aspen regeneration or other vegetative conditions could change the short-term character of the landscape in some local areas. Short-term effects to scenery from these types of activities include: unnatural appearing slash piles, stumps, bare soil, and scars on remaining vegetation. Stumps, slash, and edge effects of newly treated areas, depending on the intensity of the treatment, can result in a forest that appears moderately altered in the short term. In the short term, reducing the amount of slash, woody debris, and visible stumps after vegetation treatment greatly reduces negative effects (alternations to natural appearance) to scenic resources, as numerous studies have found that the public responds negatively to downed wood, slash, visible tree stumps, and other debris from vegetation management activities (Daniel and Boster 1976, Ribe 1989, Ryan 2005). Alternatives B (modified), C, and D address mitigation of these impacts more explicitly than alternative A, but a proper review of literature and proper use of visual management system should result in the same outcomes at the project level. Project design

and/or mitigation would consider scenic resources under any alternative so that vegetation composition and structure across the landscape would appear natural in the short term to the extent possible, but particularly in the long term.

The cutting of understory vegetation component, which may occur in fuels reduction activities, typically opens up forested stands to a more parklike vegetative mosaic and provide more visual access into forested stands, a preferred scenic setting in some landscapes. In many instances, variety, texture, and color are actually enhanced along with the primary goal of improving wildlife and/or vegetative conditions. If properly mitigated to reduce impacts to scenery (downed wood, slash, visible tree stumps, and other debris from vegetation management activities), vegetation treatments may provide visual access into the forest and promote large tree growth and a smooth herbaceous ground cover. Depending on the location and vegetation types, such features may be part of the desired conditions of a particular landscape character. Treatments promoting aspen or maple growth would increase variety and scenic attractiveness, especially during fall color changes. The proposed management direction addressing vegetation management activities in alternative A differs from alternatives B (modified), C, and D. These differences in regard to scenery are discussed further in the environmental consequences for each alternative.

Prescribed fire activities would occur under all alternatives. All burning activities would be evident in the short term with burned, blackened vegetation, and charred ground surfaces. Grasses and shrubs typically resprout within one month and return to coverage similar to pre-fire levels within one to two growing seasons after the burn, depending on when burning occurs and moisture conditions during the growing season. Burning control lines may be evident along concern level 1 and 2 travel routes, but are usually softened by the burning activities. In the long term, prescribed burning usually increases the diversity of texture, color, vegetative size classes, and distribution across the landscape. In the short and long terms, prescribed burning often creates the appearance of a more uniform ground cover, a preferred scenic setting in some landscapes. Less severe natural disturbances, such as low burn severity areas where the understory burns but most mature trees are not killed, result in preferred forests over time (Taylor and Daniel 1984). Under the visual management system (alternative A), any human-caused change, including prescribed fire, would be considered negative if not properly mitigated. The scenery management system (alternatives B (modified), C, and D) would consider whether the effects of prescribed fire move scenery toward the desired landscape character and whether those effects are part of the valued landscape character for the area. The Four-Forest Restoration Initiative (4-FRI) is a collaborative, landscape-scale initiative designed to restore fire-adapted ecosystems in the Southwestern Region. Treatments to restore fire-adapted ecosystems vary and include increased use of prescribed fire and other vegetation management treatments.

Indirect effects resulting from some methods used to manage wildfire have the potential for long-term visual impacts. Dozer lines created with heavy equipment often leave noticeable linear features that are defined by bare soil and altered contours. In wilderness, fire management techniques are typically more restrictive than in general forest areas. These are called minimum impact suppression tactics, and they reduce the scenic impact of these activities and the need for rehabilitation of wilderness character. Therefore, the more area that receives minimum impact suppression tactics, the less area would be negatively impacted by wildland fire management. The area where minimum impact suppression tactics would be applied varies by the amount of recommended wilderness increases in an alternative. Alternative C proposes the greatest area for recommended wilderness, while alternatives A and D propose the least. Smoke from prescribed fire activities may affect the ability to view an area or see clearly in the short term; however, unless the air quality deteriorates to the point that vegetation dies at visually apparent levels, no lasting effects to scenery are anticipated. Any effect would be similar for each of the alternatives.

Livestock grazing would continue under all alternatives. Livestock grazing and range facilities, such as fences and watering tanks, may be evident on the landscape. These facilities are typically small and localized, and when properly located, would have either minimal effect on or help contribute to, the scenic quality of the landscape. Livestock watering areas with extensive trailing have the potential to dominate the landscape on a small scale when viewed. Use is balanced with capacity and allotment management plans that require permittees to move their livestock so they do not concentrate in sensitive areas and/or degrade an area from over utilization. Although there could be an effect from seasonal use of bedding areas and anticipated utilization of forage, the potential for change to the existing scenery would be minimal under all alternatives.

Land special use activities, such as utility and energy corridors, road use, communication sites, cell towers, and wind energy developments would continue in all alternatives. In the short term, active construction, vegetative clearing, and other ground-disturbing activities could dominate the landscape. Utility and energy transmission corridors, along with communication sites, are generally long-term commitments of NFS lands. Increased demand is expected for additional utility lines, renewable energy sources, and State and Federal public transportation systems to serve the growing populations of Arizona and the Southwest. In the long term, operations and maintenance of permanent structures are usually greatest when these developments occur in very high or high scenic integrity areas, where operations or structures do not borrow from the form, line, color, or texture found in the characteristic landscape, such as straight, dominant edges of utility corridors. Structures with strong vertical elements may especially dominate the characteristic landscape being viewed. Project mitigation/design would consider scenic resources under any alternative. The proposed management direction addressing lands special use activities in alternative A differs from alternatives B (modified), C, and D. These differences in regard to scenery are discussed further in the environmental consequences for each alternative.

Land adjustments would continue in all alternatives. Land adjustments are typically beneficial for scenic resources because they help manage scenic resources more consistently across the landscape. All alternatives have guidelines for land adjustments and considerations for acquisition and lands that leave forest ownership (1987 Plan, pages 84 through 88), but alternatives B (modified), C, and D include specific desired conditions and guidelines related to naturally appearing landscapes and considering areas contributing to very high or high scenic integrity for acquisition. See FW-LndAdj-DC-1 and FW-LndAdj-G-1.

Low levels of mineral development and potential for geothermal development would continue in all alternatives. Mineral development can dominate the form, line, color, and texture of the characteristic landscape by exposing soils, removing vegetation, or altering natural landforms in the short and long terms. All alternatives include standards or guidelines to identify withdrawal areas or areas of no surface occupancy. Alternative A includes management direction for no surface occupancy in foreground retention VQO and to locate mineral sources to be consistent with the VQOs of the area (1987 Plan, pages 76 and 78). Alternatives B (modified), C, and D include a guideline to protect visually sensitive areas through surface occupancy restrictions, mitigation measures, and operating plan requirements (FW-Minerals-G-4). These alternatives also include a guideline to consider very high scenic integrity areas for no surface occupancy or no leasing (see FW-Minerals-G-4). The management direction in all alternatives provides for considering scenic resources in the project design and/or mitigation of energy or mineral development in all alternatives. It is assumed that, through site-specific project design, activities would move the landscape toward scenery desired conditions under all alternatives.

Road-related activities, such as road maintenance or decommissioning, would continue under all action alternatives and may be evidenced by fresh, lighter colored soils in the short term. Decommissioning of roads exposes light-colored soils in the short term, which could create noticeable color contrasts in

foreground views of the concern level travel routes and use areas. In the short term, these areas visually recover quickly as the area revegetates. In the long term, road decommissioning is typically beneficial to scenery resources by recontouring slopes to mimic natural landforms and rehabilitating and revegetating exposed soils typically noticeable on cut and fill slopes created during road construction. The Coconino National Forest Travel Management Decision (USDA Forest Service 2011g) prohibits cross-country motorized travel and consequently designates authorized motorized routes. These impacts of travel management result in more natural appearing landscapes in the long term, as they avoid the development of new unauthorized cross-country routes and allow for existing undesignated routes to be rehabilitated naturally or through decommissioning activities. Alternative A includes desired conditions and standards and guidelines for transportation facilities (1987 Plan, pages 24 and 91). Alternatives B (modified), C, and D have desired conditions, objectives, standards and guidelines guiding road facility maintenance and road decommissioning activities (FW-Scenic-DC-9, FW-RdsFac-DC-1 through 8, FW-RdsFac-O-1, FW-RdsFac-S-1 and FW-RdsFac-G-1 through 10). It is assumed that, through site-specific project design, activities would move the landscape toward scenery desired conditions under all alternatives.

Outdoor recreation activities, both developed and dispersed, would continue in all alternatives. Developments for recreation activities are evident, such as roads, trails, and campground and trailhead facilities, and they are appropriate for the ROS setting (generally urban, rural and roaded natural). ROS incorporates the naturalness of scenery as one of the variables of the setting characteristics. When facilities are properly located and designed to blend with the surrounding landscape, they have minimal effects to scenery. Additionally, recreation facilities that conform to the cultural landscape are also appropriate in high scenic integrity areas in urban, rural, or roaded natural ROS (see “Recreation Setting” in the Recreation section of this FEIS for more information on ROS). An example of where this is appropriate is along scenic byways such as the Route 66 All-American Road, which is primarily designated for its cultural importance and not its natural setting. The location of facilities affects the surrounding setting because they raise the level of concern by becoming viewing platforms for visitors.

All alternatives include desired conditions to not diminish aesthetic values of cave resources. They vary in how they address other types of geological resources (see “Geological Resources” section).

The anticipated effects of climate change on scenic resources would be the same in all alternatives. No direct effects to scenic resources are expected during the life of the plan. In the long term, beyond the life of the plan, climate change may affect forest and grassland ecosystems, and how people relate to them (USDA Forest Service 2010c). Over time, the boundaries of the identified desired landscape character, as described for each management area, may shift due to changes in vegetation types. If climate change causes changes in the natural environment, an increased value may be placed on natural forested landscapes for recreation (USDA Forest Service 2010c, pp. 25–26) which, in turn, is likely in increase demand for high scenic integrity landscapes and a higher concern for scenic resources.

Alternative A

When the 1987 plan was adopted, scenic resources were inventoried and analyzed using the visual management system as outlined in Forest Service Handbook 462 (USDA Forest Service 1977). This system, which was released in 1977, established standards of measurement (i.e., VQOs) for assessing proposed and existing impact to scenic quality.

Under alternative A, scenic resources would continue to use VQOs, developed from the 1987 visual management system inventories, to manage scenic resources. VQOs of preservation, retention, partial retention, modification, and maximum modification are allocated to NFS lands in the 1987 plan.

The 1987 plan visual resource planning and inventory forestwide standards and guidelines include, but are not limited to, the following:

> "Revise and update the visual resource inventory during the first decade. Inventory the visual absorption capacity and the existing visual quality level of the forest in the first decade. Projects are planned to meet or exceed VQO." (1987 Plan, page 60)
>
> "Review the VQO inventory as a part of project planning and make necessary corrections/refinements following field checking. Use VQO inventory to analyze impacts to VQO classes due to management activities such as timber sales, range projects, and firewood sales. Use the current Forest Visual Resource Management Inventory that lists VQO forestwide in conjunction with Forest Plan MA Map and descriptions to plan projects. Acceptable forestwide variation is + 15 percent in each VQO class and relates to the changes from the updated inventory, except no change is allowed in Preservation…." (1987 Plan, page 60)
>
> "Allow only one classification movement downward unless a larger movement is justified after doing an environmental analysis for emergency situations such as removal of fire damaged timber or I&DC control needs...." (1987 Plan, page 60)

The corporate VQO GIS data layer was updated in 1992, resulting in the VQO allocations summarized in table 52.

The guideline that allows for one VQO classification movement downward (1987 Plan, page 60) has been applied on numerous projects during the life of the 1987 plan, with updates to the corporate VQO data layer being inconsistent. Since any site-specific project may move the VQO classification downward without a forest plan amendment, the corporate VQO data layer is likely not accurate and the scenic resources of the forest are at risk to decline and move away rather than toward the desired condition for scenery. The percentage of retention and partial retention VQOs are likely lower than what currently shows in the corporate VQO data layer and may continue to decrease due to the guideline allowing one VQO classification movement downward. As a result, the scenic integrity across the landscape would decrease.

Most human alterations, even when planned to improve ecosystem processes, would also be considered negative without site-specific mitigation identified during project-level analysis. The established duration of impact for VQOs in the visual management system handbook would be beneficial for enhancing or maintaining high scenic quality in retention and partial retention VQO areas. However, this is offset by the forest plan guideline that allows for one VQO classification movement downward (1987 Plan, page 60). By allowing for one VQO classification downward, scenery may be managed at a lower level than what is desired. This guideline especially puts scenery in retention and partial retention VQO at risk with evidence of activities being more evident or dominant in the landscape that what the desired condition would allow.

An indicator for this analysis is the acres of the Coconino NF managed for natural-appearing scenery. Managing for preservation, retention, and partial retention VQOs would generally result in a natural-appearing landscape. Under alternative A, about 45 percent of the forest would be managed for natural-appearing scenery. This amount would be lower if the VQO classification is moved downward by one classification during any site-specific project planning.

Table 52. Visual quality objectives allocated in the 1987 plan

Visual Quality Objective[1]	Acres	Percent of Forest	Percent of Forest[2]
Preservation Allows for ecological changes only; management activities are prohibited, with exception of very low visual impact recreation facilities.	156,491	8	8
Retention Management activities are not visually evident.	246,285	13	13
Partial Retention Management activities remain visually subordinate.	453,914	24	11
Modification May visually dominate characteristic landscape, but must follow naturally established line, form, color, etc.	930,661	50	68
Maximum Modification Management activities may dominate landscape, but mostly appear to borrow from characteristic form, color, line, etc.	65,735	4	

Note: Acreage calculations only include NFS lands. These acreage calculations are based on the corporate VQOs GIS data layer dated 1992. The total acres are, therefore, less than those for alternatives B (modified), C, and D, which are based on all lands within the administrative boundary regardless of ownership.

[1] Per corporate 1992 VQOs GIS data.

[2] Per 1987 plan direction ("Coconino National Forest Draft Land Management Plan," USDA Forest Service 1987a, page 60).

As the 1987 plan has been amended, some aspects and terminology of the scenery management system have been incorporated. However, this has been inconsistent and not based on the full spectrum of scenery management system inventories. Areas under amendments 12 and 17 have management direction recognizing positive cultural attributes for their inherent scenic value and other management direction focusing on sustaining ecological processes. The terminology used for scenery in these amendments is from the scenery management system, but the scenery management system inventory process for these areas was not completed and scenic integrity objectives were not established. As scenic integrity objectives were not established, VQOs are still used to manage scenery in the amendment areas, so all the benefits of the scenery management system are not fully realized.

Alternative A would not use the scenery management system, although it is considered to be the most current and best available science to manage scenic resources in the context of ecosystem management to sustain scenic resources in the long term. Forestwide direction for scenery would not focus on moving the landscape toward the desired condition for scenic resources. Alternative A also would not establish landscape character descriptions to guide management of scenic resources. As a result, scenic integrity would decrease across the landscape over the long term and implementation of ecological restoration would be in conflict with the visual management system. This could lead to less effective implementation of ecological restoration, and as a consequence, would be less successful at decreasing the risk of uncharacteristic wildfire.

For vegetation activities, the 1987 plan includes specific standards and guidelines for designing openings and timber stand management to be consistent with the characteristic landscape or to meet VQOs in the following management areas: pinyon-juniper woodlands on less than 40 percent slope; ponderosa pine and mixed conifer on less than 40 percent slope; and aspen (1987 Plan, including but not limited to pages 133, 134, 141, 142, 154). This management direction would ensure that openings blend with the characteristic landscape to meet VQOs.

Alternative A proposes the least area for recommended wilderness (0 acres) and, therefore, would result in the most potential negative indirect effects associated with wildfire management as discussed in the

Environmental Consequences Common to All Alternatives section. Alternative A would result in wilderness trending away from desired conditions for fire and vegetation due to restrictions in wildland fire use in wilderness, and such effect would negatively impact scenic resources (see Fire and Vegetation section).

For lands special uses, alternative A includes a forestwide guideline to use existing corridors to capacity with compatible utilities where additions are visually acceptable before evaluating new routes. Alternative A does not include management direction for transportation specifically mentioning scenic resources. The alternative A management direction specific to scenery for these activities would rely more on forestwide direction to meet desired conditions (VQOs), but these activities on a site-specific basis may have a VQO one classification lower than what is desired because of the forestwide guideline allowing this movement downward. Alternative A includes some goals, objectives, and guidelines for blending infrastructure, facilities, and recreation developments specific to amendment 12 and 17 areas, but not forestwide. Outside of the amendment 12 and 17 areas, these activities on a site-specific basis may have a VQO one classification lower than the established VQO, due to the forestwide guideline allowing this movement downward.

Alternative B (modified)

During the development of the proposed revised plan, a full inventory of scenic resources was conducted using the scenery management system as outlined in the Scenery Management System Handbook (USDA Forest Service 1995a). As part of the interdisciplinary revision process, proposed scenic integrity objectives were developed from the scenery management system inventories and landscape character descriptions were developed for the landscape character zones on the forest. Scenic integrity objectives have been proposed for every acre of NFS lands from very high to low (table 53). The forest's landscape character descriptions are found in a separate document titled Landscape Character Descriptions (USDA Forest Service 2016l). It is part of the proposed revised plan to fully implement the scenery management system including goals, objectives, standards, and guidelines to manage scenic resources in the context of ecosystem management.

An indicator for this analysis is the acreage of the Coconino NF managed for natural-appearing scenery. Managing for very high, high, and moderate scenic integrity objectives would generally result in a natural-appearing landscape. Under the proposed revised plan, about 99 percent of the forest would be managed for natural-appearing scenery. Any proposed activities, such as vegetation management or lands special uses may need project design upfront or mitigation during site-specific project planning to reduce an activity's form, line, color, or texture contrasts with the existing scenic integrity or be designed in such a way that the project is moving the scenery toward the desired scenic integrity objective.

The proposed revised plan includes the following objective: "Rehabilitate at least 25,000 acres that do not meet or exceed their desired SIO by at least one level within 10 years of plan approval (see "Scenery Rehabilitation Map") (FW-Scenic-O-1). Alternative A does not include an express objective for scenery rehabilitation. In the context of scenery management, rehabilitation is a short-term management goal used to return a landscape with existing visual impacts and deviations to a desired level of scenic quality formerly found in the natural landscape.

Table 53. Proposed scenic integrity objectives

Scenic Integrity Objective	Acres	Percent of Forest
Very High Highest possible level of intactness with a primitive and natural sense of place.	208,421	11

Scenic Integrity Objective	Acres	Percent of Forest
High Natural appearing; intact and deviations are not evident.	669,408	36
Moderate Appears slightly altered due to transportation system, recreation developments, vegetation management, etc.	953,811	52
Low Visual disruptions may dominate the landscape.	11,322	1
Very Low Alterations may strongly dominate the landscape.	0	0

Note: Acreage calculations only include NFS lands.

Most of the forest (about 78 percent) currently meets or exceeds the desired condition for scenery, but about 19 percent of the forest would need scenic rehabilitation by one level to meet the desired condition for scenery. Table 54 shows the acreage exceeding and meeting desired conditions for scenery and those acres identified for rehabilitation.

Table 54. Scenery rehabilitation acreage

Summary	Acres	Percent of Forest
Exceeds scenic integrity objective (desired condition)	188,109	6
Meets scenic integrity objective (desired condition)	1,322,194	72
Rehabilitate (1 level to meet scenic integrity objective)	352,810	19
Rehabilitate (2 levels to meet scenic integrity objective)	39,138	2
Rehabilitate (3 or more levels to meet scenic integrity objective)	4,065	<1

Note: Acreage calculations only include NFS lands.

The proposed objective for scenery would move the landscape toward the desired condition for scenic integrity by providing direction to rehabilitate areas not currently meeting proposed scenic integrity objectives. Management activities identified to rehabilitate scenery are anticipated to be able to improve scenic integrity by one level on a site-specific basis during the life of the plan. Improving the scenic integrity would move the rehabilitated area toward a more natural appearing landscape. In areas identified for rehabilitation, existing visual impacts may be managed through site-specific projects, such as vegetation treatments, fuels reduction, prescribed fire, etc., to improve the scenic integrity in the long term. Any of the areas identified for rehabilitation, if improved by one scenic integrity objective, would meet the objective. Areas identified to be rehabilitated by two or more levels may not realize the overall desired scenic integrity for several planning cycles. The scenery rehabilitation map for alternative B (modified) can be found in appendix A of this FEIS.

In addition to the scenic resource rehabilitation objective, alternative B (modified) includes forestwide desired conditions, a standard, and guidelines for scenic resources, and landscape character descriptions contained in a separate document (USDA Forest Service 2016l). Key scenery management direction, including goals and guidelines, from the 1987 plan amendments Sedona-Oak Creek Ecosystem (amendment 12) and the Flagstaff/Lake Mary Ecosystem Analysis (amendment 17) is also included in alternative B (modified). Scenery goals and guidelines similar to those in amendments 12 and 17 may be in different management areas than alternative A, but the intent is still found for the affected areas. For example, the Volcanic Woodlands Management Area includes desired conditions found in amendment 17, and forestwide guidelines for scenery in alternative B provide for natural-appearing scenery, which would

be applicable to all management areas. Providing for natural and natural-appearing scenery was a main focus of amendment 12, and the proposed very high, high, and moderate SIOs for this area continue to provide that focus.

The first forestwide guideline for scenic resources, "management activities and permitted uses should be designed and implemented to maintain or move toward the desired SIOs," ensures that SIOs would be met by site-specific projects (FW-Scenic-G-1).

The forestwide standard for scenery addresses potential changes to SIOs:

> "Management activities that are unable to maintain or move toward the desired SIO and whose effects persist in the long term shall not occur unless a decision is made to change the SIO" (Revised Plan Footnote for Standard: A decision to change the scenic integrity objectives will be documented in a project-level NEPA decision document and in the plan Desired Scenic Integrity Objective Map. A plan amendment may be needed depending on the site-specific circumstances.) (FW-Scenic-S-1)

This standard ensures that any changes in the scenic integrity objective would be documented in a project-level NEPA decision and in the plan desired scenic integrity objective map. Any changes to the desired conditions for scenery properly documented through this guidance would help monitor changes to scenery in the life of the plan. The remainder of this section discusses how the management direction of alterative B relates to activities discussed in the environmental consequences common to all alternatives section.

For vegetation treatments, guidelines for all scenic resources in alternative B (modified) include reducing the visibility of management-created debris such as slash and slash piles from concern level 1 and 2 travel routes (FW-Scenic-G-3). Guidelines are also proposed in alternative B (modified) to reduce the visibility of stumps and minimize their impacts from concern level 1 and 2 travel routes (FW-Scenic-G-4). These guidelines, along with the proposed SIOs, would manage for natural-appearing scenery and reduce negative effects of vegetation management activities to scenery viewed in concern level 1 and 2 travel corridors.

In regard to fire management, alternative B (modified) would allow fire to play a more natural role on the landscape. It is expected that effects of fire discussed in the Effects Common to All Alternatives section would be evident across the forest, particularly in fire-adapted ecosystems such as ponderosa pine under this alternative. By implementing the scenery management system in alternative B (modified), however, the effects of fire, burning in the natural disturbance regime of fire-adapted ecosystems, would be part of the desired condition of the landscape character. Typically, when fire burns with low intensity and severity or in a mosaic pattern, the valued landscape character attributes would be intact or mostly intact. However, large-scale disturbances, such as when fire uncharacteristically results in mortality across scales outside the historic range of variability, tend to change the landscape character of an area by altering the physical appearance of the landscape that contributed to the area's identity and sense of place. "In general, natural forest disturbances that result in extensive areas of dead or dying trees (Haider and Hunt 2002, Ribe 1989) such as the destruction of the forest by fire or flooding are perceived negatively (Daniel 2001, Fanariotu and Skuras 2004, Gobster, 1994 and 1995)," (as cited in Ryan 2005, page 17). However, it should be noted that disturbances with high mortality, depending on vegetation types and ecosystem processes, may be part of the historic range of variability and natural disturbance regime (chaparral). Overall, occurrences of large uncharacteristic wildfires would likely decrease as progress is made toward vegetative desired conditions and reduce the likelihood of negative effects (e.g., altering the physical appearance of the landscape) to scenic resources.

A proposed scenery guideline recognizes that evidence of fire management should only be apparent in the short term, as determined by site-specific information (FW-Scenic-G-2). This guidance would help manage scenic resources in an ecosystem context, recognizing that some activities have effects that are common to the landscape character and help sustain scenic resources in the long term, but also ensure the proposed SIOs are maintained.

For lands special use activities, alternative B (modified) provides desired conditions and guidelines for meeting scenic resource desired conditions and proposed SIOs in the long term (FW-SpecUse-DC-3, 7, and 9, FW-SpecUse-G-4, 5, 6, 7, 8, and 11). These desired conditions and guidelines would manage for natural-appearing scenery and would help in meeting proposed SIOs for any future site-specific projects.

For roads-related activities, alternative B (modified) includes a forestwide management approach identifying very high or high scenic integrity areas as a factor for prioritizing the naturalization of decommissioned and unauthorized roads, which would move the landscape toward the desired SIOs in these areas (FW-RdsFac-MgtApp). Desired conditions for all scenic resources also recognize that some viewing platforms such as roads and parking areas often create more contrast than would be acceptable in areas identified for high and moderate SIOs, and they go on to describe expectations of such structures (FW-Scenic-DC-8 and 9). These desired conditions and management approach would manage for natural-appearing scenery, while recognizing the need for viewing platforms and their improvements for access, safety, and scenery viewing opportunities.

Alternative B (modified) includes forestwide guidelines for infrastructure and facilities to ensure that the built features on the landscape reflect their place within the natural and cultural landscape (FW-RdsFac-G-10). In order to reflect the natural landscape, infrastructure and facilities would use natural colors similar to those of the natural environment, and infrastructure and facilities would borrow from the form, line, color, and texture of the landscape character. This guidance would help meet desired SIOs and landscape character in the long term for these types of activities.

Under alternative B (modified), the Red Rock, Oak Creek Canyon, Sedona Neighborwoods, and House Mountain-Lowlands Management Areas are primarily managed for very high and high SIOs to maintain and enhance the natural and natural-appearing scenery of the area. The proposed SIOs, along with the scenery-related forestwide and management area desired conditions and guidelines would be in line with the intent of the potential national scenic area designation that would overlap these management areas.

Although little livestock grazing is occurring in research natural areas and botanical and geological areas, the guideline for grazing allotment management plans to have provisions to protect the uniqueness and/or ecological condition of these areas (SA-RNABotGeo-G-4) would likely result in more vegetation and a lack of erosion in riparian areas. These areas would appear less altered and more natural, which would improve their scenic integrity in the short and long terms.

Alternative C

The guidance on scenic resources for alternative C is similar to alternative B (modified). Alternative C would also fully implement the scenery management system to manage scenic resources. Proposed SIOs in this alternative differ from those proposed in alternative B (modified). The desired conditions, objectives, standards, and guidelines to manage scenic resources would be same as alternative B (modified). The consequences for alternative C would be the same as alternative B (modified), except for the following:

- Alternative C has some relevant differences from alternative B (modified) in that alternative C: recommends 13 new wilderness areas; identifies 8 additional management areas that emphasize reduced human-related disturbance; and restricts grazing in research natural areas unless grazing

supports or would not affect the research purpose of that research natural area. The additional recommended wilderness areas would result in additional acres being proposed with a very high SIO. See table 55. The recommendation and designation of the mentioned areas would have positive indirect effects on scenic resources.

- Managing recommended wilderness areas for more primitive or pristine ROS settings and the modified management area direction would improve the scenic integrity by allowing for the limitation or reduction of specific management activities, which would result in fewer impacts to the scenic resources in those areas. Fewer impacts would allow for a landscape that appeared unaltered and expressed a very high level of intactness, thereby resulting in more natural scenic conditions. Desired conditions to promote, restore, and maintain aspen and big tooth maple would provide for more distinctive scenic attractiveness in these areas. In the long term, the scenic integrity would achieve very high SIO in recommended wilderness areas. Alternative C proposes the most area for recommended wilderness, resulting in the least potential negative indirect effects associated with wildfire management as discussed in the environmental consequences common to all alternatives section.
- The changes in SIOs in recommended wilderness areas would affect identified scenic rehabilitation opportunities.

The restriction of grazing in research natural areas would improve the scenic integrity in these areas in the short and long terms. Other differences between alternatives B (modified) and C, including suitable uses regarding recreation, are not expected to affect scenic resources in those areas.

Like alternative B (modified), the proposed SIOs in alternative C focus on movement toward landscape character descriptions and provide more emphasis on providing for natural-appearing scenery than the VQOs established in the 1987 plan. See table 55 for a comparison of SIOs and VQOs across alternatives.

Table 55. Acres of scenic integrity objectives or visual quality objectives

SIO[1]	VQO[2]	Alternative A Acres	Alternative B (modified) Acres	Alternative C Acres	Alternative D Acres
Very High	Preservation	156,491	208,421	247,485	207,573
High	Retention	246,285	669,408	630,658	669,797
Moderate	Partial Retention	453,914	953,811	953,499	951,777
Low	Modification	930,661	11,322	11,320	13,815
Very Low	Maximum Modification	65,735	0		

[1] Per scenery management system used in alternatives B (modified), C, and D.

[2] Per visual management system used in alternative A.

Alternative A manages about 45 percent of the forest for natural-appearing scenery; while alternatives B (modified), C, and D manage most of the forest (about 99 percent) for natural-appearing scenery. Alternative D manages for less natural-appearing scenery (about 2,348 acres of low SIOs in power line corridors) than alternatives B (modified) and C, but the overall percentage of the forest managed for natural-appearing scenery for the action alternatives is the same (see table 56). As stated earlier, it is important for national forests to manage scenery at this level. “Research has shown that high-quality scenery, especially that related to natural-appearing forests, enhances people’s lives and benefits society” (USDA Forest Service 1995a, page 17). It should also be noted that according to Floyd Newby’s findings, “people expect to see natural or natural-appearing scenery” (USDA Forest Service 1995a, pp. 2–3). Furthermore, “research shows that there is a high degree of public agreement regarding scenic preferences. This research indicates that people value most highly the more visually attractive and

natural-appearing landscapes" (USDA Forest Service 1995a, page 30). Table 56 compares the indicators identified for scenery across alternatives as discussed above.

Table 56. Indicators for scenery

Indicator	Alternative A	Alternative B (modified)	Alternative C	Alternative D
Applies ecosystem science approach to manage scenery	No	Yes	Yes	Yes
Establishes desired SIOs related to landscape character descriptions	No	Yes	Yes	Yes
Identifies areas for scenery rehabilitation	No	Yes	Yes	Yes
Acres managed for natural-appearing scenery	856,690 (46% of forest)	1,831,640 (99% of forest)	1,831,642 (99% of forest)	1,829,147 (99% of forest)

Alternative C includes the same objective for scenery rehabilitation as alternative B (modified). Under alternative C, most of the forest (about 77 percent) currently meets or exceeds the desired condition for scenery, and about 20 percent of the forest would need scenic rehabilitation by one level to meet the desired condition for scenery. The scenery rehabilitation map for alternative C can be found in appendix A of this FEIS. All other effects for scenery rehabilitation would be the same as those described for alternative B (modified).

Alternative D

The guidance on scenic resources for alternative D is similar to alternative B (modified). Alternative D would also fully implement the scenery management system to manage scenic resources. SIOs proposed in this alternative differ slightly from those in alternative B (modified). See table 55. A map of the proposed SIOs for alternative D can be found in appendix A of this FEIS.

Alternative D proposes about 2,495 acres of low SIO between the Sycamore Canyon and Red Rock-Secret Mountain Wilderness Areas and along State Highway 87 (see table 53 for acres in each proposed SIO for alternative D). The power line corridor between Sycamore Canyon Wilderness and Red Rock-Secret Mountain Wilderness is proposed as low SIO instead of moderate, and an energy corridor along State Highway 87 is proposed as low SIO instead of moderate or high. In these low SIO areas, views from Sycamore Canyon Wilderness and Red Rock-Secret Mountain Wilderness and State Highway 87 would be managed for scenery that appears moderately altered with human alterations, which may dominate the landscape being viewed. When compared to high or moderate SIOs, less project mitigation would occur in low SIO to borrow from the form, line, color, or texture found in the landscape character. The alterations in these areas may have features such as straight, dominant edges of utility corridors, which may dominate the characteristic landscape being viewed.

Alternative D also has fewer acres of very high SIO than alternative B (modified) because the Abineau and Davey's recommended wilderness areas are not included in this alternative.

The desired conditions, objectives, standards, and guidelines to manage scenic resources would be the same as alternative B (modified) with one additional management approach affecting scenery proposed in alternative D. The new management approach states "When management activities or permitted uses conflict with high or very high scenery integrity objectives, work with proponents to find a location with a moderate scenery integrity objective or lower." The additional management approach would help maintain scenery in very high and high SIO areas by working with proponents to find a location in

moderate scenic integrity objective or lower, when management activities or permitted uses conflict with high or very high scenery integrity objectives.

Alternative D, like alternative A, proposes no recommended wilderness areas, resulting in the most potential negative indirect effects associated with wildfire suppression as discussed in the "Environmental Consequences Common to All Alternatives" section. Any other differences between alternatives B (modified) and D are not expected to affect scenic resources. Other than the differences discussed in this section, the environmental consequences for alternative D would be the same as alternative B (modified).

Alternative D includes the same objective for scenery rehabilitation as alternative B (modified). Although there are some differences in where scenery rehabilitation would be needed under alternative D, the overall percentages are the same as those described for alternative B (modified). See table 54. The scenery rehabilitation map for alternative D can be found in appendix A of this FEIS. All other effects for scenery rehabilitation would be the same as those described for alternative B (modified).

Cumulative Effects

The cumulative effects analysis timeframe for scenic resources is the next 10 to 15 years and the area is the Coconino NF and the lands adjacent to and within the Coconino NF under other ownership. Cumulative consequences are those consequences of past, present, and foreseeable activities on lands of other ownership that, in conjunction with management activities likely to occur on the forest, may intensify, negate, improve, or otherwise affect scenic resources. Below are considerations of consequences of activities that would likely occur on lands of other ownership adjacent to or near the forest. The forest shares borders with the Apache-Sitgreaves, Kaibab, Prescott, and Tonto National Forests; private land; and lands administered by the State of Arizona and National Park Service. It is within several miles of the Navajo Nation.

Any guiding documents or plans for lands in and around the forest were reviewed to determine if they would contribute to cumulative consequences. If lands have some management direction (e.g., goals, objectives, guiding principles, etc.) for scenic resources or natural character, it was assumed that scenic resources would be considered in any future project planning.

The Apache-Sitgreaves, Kaibab, and Prescott National Forests have revised their forest plans. The plan revisions of these forests implement the scenery management system. The Tonto National Forest has begun its plan revision process, but still manages scenic resources using visual quality objectives. Consistent management of scenic resources would be beneficial to scenery that appears unaltered by humans in the long term, especially when scenery objectives (SIOs or VQOs) are edge-matched across forest boundaries. These combined management efforts should positively contribute to scenic resources on the Coconino NF under any alternative. Alternatives B (modified), C, and D would manage scenic resources more consistently across national forest boundaries than alternative A because those alternatives implement the scenery management system. Alternative A would retain the visual management system. The scenery management system is being used by adjacent national forests, and is similar to the management styles of other land managers and private landowners. Adjacent forest proposed SIOs were reviewed to ensure as much consistency as possible in allocating Coconino NF proposed SIOs. Because the Tonto National Forest is still using the visual management system, some inconsistencies across the Coconino and Tonto National Forest boundaries may occur under alternatives B (modified), C, and D, most of which would affect joint management of the Fossil Creek Wild and Scenic River corridor until the Fossil Creek comprehensive river management plan amends both forest plans.

A comprehensive river management plan is being developed for the Fossil Creek Wild and Scenic River that would protect and enhance the free-flowing condition, water quality, and outstandingly remarkable

values, and it would allow other uses that do not substantially interfere with public use and enjoyment of the river's values. The comprehensive river management plan includes desired conditions for natural-appearing scenery and promoting a unique sense of place and rustic appearance. Another desired condition is that communication sites and utilities are not visible from concentrated recreation areas and trails within the corridor. The comprehensive river management plan would amend the forest plan under any alternative with the management direction. This direction would be consistent with managing for high quality scenery in any alternative. Management actions under the comprehensive river management plan would contribute positively to the scenic resources associated with Fossil Creek and the Coconino NF under any alternative.

The Federal Highway Administration and Arizona Department of Transportation do not manage specifically for scenic resources. The travel routes they manage provide major access for recreation activities and opportunities for viewing scenery. When Federal Highway Administration or Arizona Department of Transportation projects, within or adjacent to the Coconino NF, are coordinated with forest staff, mitigation for scenery may be incorporated to reduce effects to scenic resources from activities such as road construction or reconstruction. This coordination would reduce the appearance of human alteration of the natural landscape, which would positively contribute to the scenic resources on the Coconino NF under any alternative.

Arizona State Land Department manages State Trust Lands to optimize economic benefit for the trust beneficiaries (including K-12 schools, universities, and public institutions). While these lands permit public access, they are not managed like other public lands such as national forests or parks. As these lands are managed, leased, or auctioned, scenic resources may or may not be considered in that action. Development of these lands would reduce their natural appearance and negatively contribute to scenic resources on the Coconino NF under any alternative. Alternatives B (modified), C, and D would manage scenic resources more consistently with other management plans, land use plans, or guiding principles than alternative A. Alternatives B (modified), C, and D have management approaches that remind forest managers to cooperate with other landowners or land managers on the management of scenic resources. This cooperation should result in more consistency across ownership boundaries in how scenic resources are considered and managed for natural and natural-appearing scenery.

Walnut Canyon, Sunset Crater Volcano, and Wupatki National Monuments (National Park Service) include outstanding scenic resources within and adjacent to the Coconino NF. Management plans include management direction to preserve, protect, and maintain geological formations, ancient or historic features, and cultural and natural resources for scientific interests and research, and for public interest, including scenic, recreational, educational, social, and historic pursuits. The Navajo Nation Parks and Recreation has a vision including "Lands characterized by vast open spaces would preserve sacred areas, natural landscapes and abundant scenery" (Navajo Nation Parks and Recreation 2011). With emphasis on preserving, protecting, and maintaining natural resources, including scenic pursuits, it is anticipated that any cumulative consequences would promote natural or natural-appearing scenery on the Coconino NF under any alternative. Alternatives B (modified), C, and D would manage scenic resources more consistently with the management plans for these parks than alternative A. Alternatives B (modified), C, and D have management approaches that remind forest managers to cooperate with other land managers on the management of scenic resources. This cooperation should result in more consistency across ownership boundaries in how scenic resources are considered and managed for natural and natural-appearing scenery.

The designation of the Rogers Lake County Natural Area in Coconino County includes management and protection efforts to ensure conservation of striking scenic vistas. The Coconino Parks and Open Space Program is anticipated to benefit scenery as well. These combined management efforts should positively

contribute to scenic resources on the Coconino NF under any alternative. Alternatives B (modified), C, and D would manage scenic resources more consistently with the management plans for this natural area than alternative A. Alternatives B (modified), C, and D have management approaches that remind forest managers to cooperate with other land managers on the management of scenic resources. This cooperation should result in more consistency across ownership boundaries in how scenic resources are considered and managed for natural and natural-appearing scenery.

The Flagstaff Regional Plan is a development and preservation guide for the city and its surrounding region. The regional plan is anticipated to be formally adopted by the Coconino County Board of Supervisors and Flagstaff City Council before being ratified by the voters. Although the regional plan may not specifically mention scenic resources, it includes guiding principles to preserve the unique sense of place and concepts to ensure that growth occurs in harmony with its natural environment. The Yavapai County Comprehensive Plan and Verde Valley Regional Land Use Plan both include objectives to practice scenic conservation and protect scenic views. The Beaver Creek Community Plan includes goals and objectives to monitor the protection of scenic views and explore the possibilities of designating scenic roads. Such goals, objectives, or concepts, which promote natural-appearing scenery with fewer noticeable differences across boundaries, would have beneficial cumulative consequences on the scenic resources of the Coconino NF under any alternative. Alternatives B (modified), C, and D would manage scenic resources more consistently with these regional management plans than alternative A. Alternatives B (modified), C, and D have management approaches that remind forest managers to cooperate with other land managers on the management of scenic resources. This cooperation should result in more consistency across ownership boundaries in how scenic resources are considered and managed for natural and natural-appearing scenery.

Most private lands do not have regulations for scenic resource management. Consequently, developments on these lands can result in areas where human alteration of the natural landscape is more obvious and observable. Sometimes management activities occurring on ownership boundaries can be quite noticeable if the change in form, line, color, or texture of the activity follows ownership boundaries rather than a natural landscape feature. If activities on private lands are designed to lessen impacts to scenic resources, the difference between private lands and NFS lands are less apparent. The regional, county, and community plans' inclusion of scenic or aesthetic resources or open space character helps promote the management and value of scenic resources across ownership boundaries in the cumulative consequences analysis area. These altered areas next to NFS lands can impact scenic resources when viewing the continuous landscape. Forest visitors often view scenery as a continuous landscape with little discernment regarding the landownership being viewed. Development of these lands would reduce their natural appearances and negatively contribute to scenic resources on the Coconino NF under any alternative.

Mineral Resources

Affected Environment

Public domain lands on the Coconino NF are available for exploration, development, and extraction of mineral resources except where lands have been withdrawn from mineral entry. All minerals activities including locatable, leasable, and common variety mineral materials are subject to Federal, State, and local laws and regulations to protect the environment.

The Coconino NF has very few locatable mineral resources, and no oil and gas leases or developments, but it has potential geothermal resources (no current leases, no developments) associated with the San Francisco Volcanic Field. Locatable minerals with past or current production have included manganese, gypsum, flagstone, and pumice. The forest has a small amount of common variety mineral materials

production including: cinders, crushed and pit run aggregate, rock and fill dirt, and landscape rock/decorative stone. Most of the use of mineral materials on the forest is in-service use and by Coconino County under permits or other agreements. In-service use is use by the Forest Service or authorized contractors or permittees for projects. Aggregate production and saleable minerals are anticipated to increase with future forest restoration activities. Some areas are withdrawn from locatable mineral entry.

Mining activity on the forest falls into three legal and regulatory categories: (1) locatable materials which include hard rock minerals like manganese (which is subject to mining claims); (2) saleable permitted mineral activities such as sand, gravel, and common building stone; and (3) leasable minerals, which include geothermal resources and oil and gas.

Exploration and Mining History and Mineral Resources

Past mining exploration is important to consider when evaluating existing mineral resources and future mineral potential. However, because economic values of mineral resources constantly change, as does technology to produce and process minerals, past mineral occurrences may have future production and uses with technological advances, new uses, and higher values of the minerals.

Mineral Commodities Explored for and Mined on the Forest

Historically, there has been limited mining activity on the forest. The most common commodity and mine types listed are surface pits and borrow sources for cinders, pumice and sand, and gravel. Past exploration and production on the forest has included the following mineral commodities: clay, coal, diatomite, gypsum, gold, silver, lead-zinc-silver, manganese, perlite, uranium, pumice, sand, gravel, and stone. Past mining production (other than aggregate and stone) has mainly consisted of manganese surface mining in the 1920s, 1940s, and 1950s; gypsum open pit mining from the 1960s to the present; sandstone landscape rock; and pumice surface mining from 1990 to 2010. Mining activities for sand, gravel, and stone occur mainly at rock pits managed on the forest and is discussed further in the section below.

Uranium occurs in the Verde Formation buttes east of Tuzigoot National Monument. The area was extensively investigated for uranium in the 1970s or 1980s, as evidenced by the many shallow trenches and surface exploratory holes and diggings. As part of their study, the Bureau of Mines (Lane 1992) sampled many locations in the area. They found that the uranium content was low overall (0.015 percent). However, it was not considered a resource at that time due to highly variable and overall low uranium content, lack of definable deposit boundaries, and discontinuous occurrences (Lane 1992). They also noted that at the time of their study, the uranium market was depressed. Given that the time of their study was the early 1990s, the uranium mining technologies and economic feasibility may have changed since the report was published. The only other uranium occurrence occurs north of Flagstaff outside of the forest (Ulrick et al. 1984). This is the Cameron Mineral District east of Gray Mountain where uranium is found in the sandstone and mudstone member of the Chinle Formation. Uranium-bearing fossil logs are common. There are many other higher potential uranium prospects in Arizona and in other states such as New Mexico and Texas that are currently being explored. Currently, as evidenced by the lack of active mining claims surrounding the Tuzigoot National Monument area, there appears to be no interest in uranium. Development of uranium in this area is unlikely during the life of the plan unless there are significant and unanticipated changes in the technology, industry, and economics of development.

Mineral Districts on the Forest

Mineral districts for Arizona (Keith et al. 1983) were defined and mapped according to geological criteria. The principal goal was to arrange known metallic mineral occurrences into discreet metallogenic systems of similar age and style of mineralization. Many of the metallic occurrences have poorly understood

geological controls and hence, many of the district boundaries will change as knowledge of both their deposits and geologic settings is improved.

There are two mineral districts on the forest: the Long Valley District for manganese and the Fossil Creek District for uranium and copper (figure 7), (Keith et al. 1983). Manganese oxide occurs at several localities near Clints Well, Blue Ridge, East Clear Creek and the Battleground Ridge area (Lane 1992). The manganese occurs as surface replacement deposits on bedding surfaces of the Kaibab limestone and sandstone and in the Moenkopi sandstone formation. Manganese also occurs as nodules or masses in weathered limestone and sandstone and as cement in rim gravel deposits. In the Clints Well and Long Valley area, manganese was first described and mined in the 1920s. Mining occurred again in the 1940s and 1950s. The ore was trenched and strip mined on the surface and evidence of the shallow trenches and dump piles still remains. Small deposits of manganese are still found. Samples collected by the Bureau of Mines as part of their study (Lane 1992) indicated that the manganese content was as high as 46.9 percent. However, the manganese oxide is not considered a resource due to the lack of sufficient quantities and discontinuous deposits of the ore.

The Fossil Creek mineral district is described as a strata-bound uranium deposit with copper in the Supai Formation associated with limestone pebble conglomerate. Four areas of bulldozer cuts show evidence of mineral prospecting within the Fossil Creek Roadless area, and mining claims were located there in the 1960s. The four copper-uranium prospect locations are mapped and described in Weir et al. (1983) and Weir and Beard (1984) in their mineral resource potential study of the Fossil Creek Roadless Area. There is no reported production known from this occurrence. Field studies conducted by the U.S. Geological Survey and the U.S. Bureau of Mines from 1980 to 1981 of the Fossil Springs Roadless area concluded that the Supai formation rocks contain only spotty occurrences of copper and uranium and has little promise of mineral or energy resources (Beard and Ellis 1984; Weir et al. 1983; Weir and Beard 1997). This mineral district is entirely within the Fossil Creek Wilderness and is partly within wild sections of the Fossil Creek Wild and Scenic River, which makes it withdrawn from mineral entry on two counts. An area of moderate mineral favorability is mapped all around the mineral district area (U.S. Geological Survey 2000). Except for a few acres outside of the wilderness boundary on the Coconino and nearly 1,000 acres on the Tonto National Forest, the area of moderate favorability is also withdrawn from mineral entry (wilderness and a wild section of the Fossil Creek Wild and Scenic River).

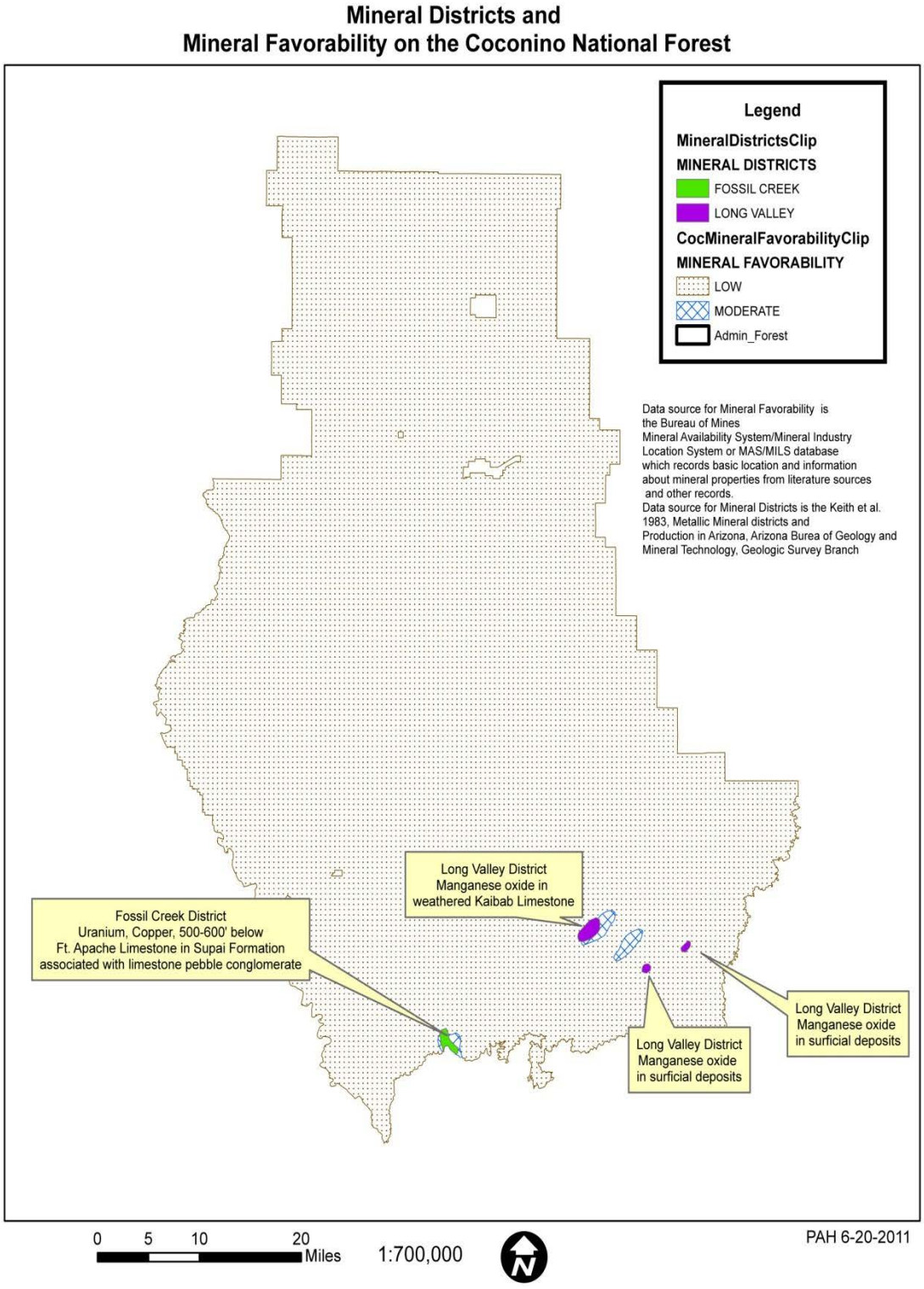

Mineral Districts and
Mineral Favorability on the Coconino National Forest
Legend
MineralDistrictsClip
MINERAL DISTRICTS
FOSSIL CREEK
LONG VALLEY
CocMineralFavorabilityClip
MINERAL FAVORABILITY
LOW
MODERATE
Admin_Forest
Data source for Mineral Favorability is the Bureau of Mines Mineral Availability System/Mineral Industry Location System or MAS/MILS database which records basic location and information about mineral properties from literature sources and other records.
Data source for Mineral Districts is the Keith et al. 1983, Metallic Mineral districts and Production in Arizona, Arizona Burea of Geology and Mineral Technology, Geologic Survey Branch
Long Valley District
Manganese oxide in
weathered Kaibab Limestone
Fossil Creek District
Uranium, Copper, 500-600' below
Ft. Apache Limestone in Supai Formation
associated with limestone pebble conglomerate
Long Valley District
Manganese oxide
in surficial deposits
Long Valley District
Manganese oxide
in surficial deposits
0 5 10 20
Miles
1:700,000
N
PAH 6-20-2011

Figure 7. Mineral districts and mineral favorability on the Coconino National Forest

Active Mining Claims

The Bureau of Land Management database, Land and Minerals Legacy Rehost 200 (LR 2000),[41] was queried to determine the number of active mining claims on the forest. Mining claims are strictly authorized and managed by the Bureau of Land Management. Knowledge of where current and past claim activity has occurred is important to understand the mineral potential of the forest and past and future trends. Having a mining claim on the forest also does not mean that active mining is taking place on the claim. In many instances, claims are filed to hold claims for sampling and exploration or other reasons, and often no mining activity is occurring.

Currently, there are about 17 located mining claims across the forest that are not a part of the Verde Gypsum Mine. Additionally, there are another 72 active mining claims in the Verde Valley area associated with the currently active Verde Gypsum Mine operated by Phoenix Cement/Salt River Materials Group and the Salt River Pima-Maricopa Indian Community. In 2011, 242.73 acres were patented on the gypsum mine, which conveyed land of the United States to the Phoenix Cement Company. There are still areas on the forest used by the Verde Gypsum Mine and covered under a plan of operations (see discussion below in active mining operations). The claim(s) associated with the Paint Rock Group that are being mined for decorative flagstone were located in 1947, and are authorized under a plan of operations (see discussion below in Active Mining Operations). There are a few other mining claims in the eastern part of the San Francisco Volcanic Field likely associated with cinders and pumice prospects. No surface disturbance or mining is occurring in that area, however, as indicated by viewing the 2013 aerial photos. Overall, the existence of a total of 17 mining claims on the forest outside of the Verde Valley indicates a very low level of mining interest or activity.

Active Mining Operations

Two active mining operations on the forest are administered under a plan of operations: the Verde Gypsum Mine and the Paint Rock Group Mine. The Verde Gypsum Mine produces gypsum for use in cement as an additive and for limited use in agricultural fertilizer. The mine has patented mining claims (private lands) and also leases land from the State Lands Department in addition to having mining claims on lands managed by the Forest Service. The Paint Rock Group Mine produces a small amount of flagstone and decorative stone. The White Vulcan Mine is a past active open-pit mine that ceased operations in 2010. It operated from 1990 to 2010, and produced pumice for stone-washing jeans and for other common uses. It is currently totally reclaimed and revegetated with no future mining permitted there.

Mineral Resource Potential of the Forest

The following information is summarized from the Mineral Resource Appraisal of the Coconino National Forest conducted by the Bureau of Mines (Lane 1992). The Bureau of Mines conducts these mineral appraisals to assist the Forest Service in incorporating mineral resource data in forest plans. All commodities are discussed in general without reference to locatable, leasable, or mineral materials authorities and regulations.

The findings from the Bureau of Mines study of the Coconino NF are summarized as follows (Lane 1992). There are gypsum and clay resources in the Verde Valley, most of which are being mined by Phoenix Cement/Salt River Materials Group on their claims and properties. The Verde Valley area outside of the Verde Gypsum mine has moderate development potential for gypsum, clay, uranium, diatomite, and limestone. There are also areas of moderate development potential for sand and gravel in the alluvial

[41] LR 2000 reports on land and mineral use authorizations for oil, gas, and geothermal leasing, rights-of-way, coal and other mineral development, land and mineral title, mining claims, withdrawals, classifications, and more on Federal lands or on Federal mineral estates.

deposits of Wet Beaver Creek, Dry Beaver Creek, Verde River, Oak Creek, and Sycamore Creek. Many of the areas mapped include private lands, wilderness, and wild and scenic rivers, so the actual development potential is limited.

Clay resources present at Rogers Lake may be useful in making lightweight aggregates; Rogers Lake is characterized as having high development potential for clay. Most of Rogers Lake is Coconino County property and is a wetlands area with prime wildlife habitat. Manganese occurrences at Long Valley, Blue Ridge, and near East Clear Creek are not considered to be a resource or have any future development potential. Volcanic cinders, which are widespread across the forest in cinder cones but are particularly abundant in the San Francisco Volcanic Field, are the primary resource of the forest for aggregates, cinder block manufacture, and decorative stone. Dimension stone is another available resource such as that in sandstones of the Coconino Sandstone and Supai, and Moenkopi Formations. These rock formations are fairly widespread across the forest. Basalt lava flows and limestone are another resource for use as aggregates for road construction and surfacing. Pumice and cinders are being mined on private lands in the northeastern part of the San Francisco Volcanic Field. Additional resources exist on NFS lands. The expected trend is for minimal future new mining development with the exception of continuing mining and exploration for gypsum in the Verde Valley.

Mineral Materials

This section describes current uses of mineral material commodities on the forest, and includes information on inactive, active, and proposed rock pits on the forest. Mineral materials resources on the forest include: cinders, crushed basalt and crushed limestone aggregate; sand and gravel (including alluvium and rim gravels); and decorative stone including malpais[42] rock, sandstone rock, limestone rock and landscaping sand, gravel, and cobbles.

Rock Collection for Personal Use

On the forest, there are several locations where the public can be issued a permit to collect rocks for personal use. These areas are:

- Mogollon Rim Decorative Stone Collection Area, Mogollon Rim Ranger District, on Forest Road (FR) 300 from FR 137 to FR 295E, not to extend 10 feet beyond bar ditches.
- A-1 Mtn. Rock Gathering Area, Flagstaff Ranger District, FR 518 and areas south of A-1 Mountain.
- Ritter Rock Collection Area, Flagstaff Ranger District, west of I-17 north of FR 253 to James Canyon.
- Tombstone Rock Gathering Area, Flagstaff Ranger District, FR 700 west of Ward Camp Tank
- Slate Rock Gathering Area, Flagstaff Ranger District, along buried pipeline that crosses US180 near Slate Lakes east to the junction of the pipeline and FR 549.
- Red Rock Picking Area, Red Rock Ranger District, FR 761B.
- Dry Beaver Rock Gathering Area, Red Rock Ranger District, east of Hwy 179 FR 9206L on floodplain of Dry Beaver Creek in the vicinity of the gaging station.

[42] Malpais rock is multicolored volcanic lava rock sometimes with lichen or moss on the surface of the stone.

Rock Pits on the Forest

Across the forest, many rock pits are open for future use and are considered "active."[43] The forest has about 33 active rock pits, which include pits evaluated in NEPA analyses, but not yet developed. The active pits also include those that are used as material of debris disposal sites. Of these, 18 rock pits were analyzed in the Coconino-Kaibab Rock Pit Final Environmental Assessment for use and expansion (USDA Forest Service 2016j).

Other rock pits are considered inactive and closed mainly due to impacts to scenery or because they have other resource concerns. A few other rock pits are not actively being used for rock resources, but are being used for disposal sites for wood debris, oversized rock, and fill soil. One rock pit site, Wing Mountain, is managed as a snowplay site in the winter. Cinch Hook rock pit is an active rock pit that the public has used in the past as a snowplay area. In recent years, it has been closed to public use year-round because of safety issues and other concerns.

The Coconino-Kaibab Rock Pit Project authorized the development, operation, and/or expansion of 18 rock pits on the forest as well as reclamation of two existing rock pits on the forest (USDA Forest Service 2016j). That project will develop 18 rock pits on the Coconino NF. Of the authorized rock pits for development and operation, 6 are entirely new rock sources and 12 are existing sources authorized for further development and expansion. The decision for the rock pit project was made in late 2016 under the current forest plan. Rock pit development and expansion were determined to be consistent with the current forest plan and would be implemented as needed over the next 20 years regardless of which forest plan alternative is subsequently selected in the forest plan revision effort.

Mineral materials use authorizations are largely comprised of mineral materials permits for salable decorative rock and cinders. Free use permits are also authorized to local agencies and non-profit groups and in service use (use by the Forest Service). In the past, the forest has permitted use of aggregate sources to Arizona Department of Transportation and Coconino and Yavapai Counties. These rock sources have included Cinch Hook Pit (crushed basalt), Salmon Lake Cinder Pit (cinders), Lockwood Pit (crushed limestone), and several others. Currently, the forest has no permits with Arizona Department of Transportation, but the forest allows free use or has permits with Coconino County at several rock sources. Coconino County has shared in the cost of crushing contracts implemented by the forest and has obtained use of the appropriate share of the material produced. In addition, the forest has permitted uses by Arizona Department of Transportation and Coconino and Gila Counties among others at rock pit sites for temporary storage of milling materials or oversized rock when they have constructed roads that cross the forest. This type of use is anticipated to occur in the future.

Construction-related materials like these are typically consumed within the local area due to transportation costs. Therefore, demand is greatly influenced by local construction activities. The demand for these materials has been low in recent years, but as the economy recovers, the demand for construction materials should increase. Demand for pit run material[44] and crushed aggregate on the forest is anticipated to increase with future forest restoration projects that include timber sales or stewardship contracts.

[43] Active rock pits are those being used by the Forest Service or other government agencies or contractors; inactive rock pits are those that are not in use; closed rock pits are those that are not in use and some efforts have been made to rehabilitate the site.
[44] Pit run material is untreated aggregate rock taken from a gravel pit or quarry that is used as fill at construction sites or to build logging roads. Pit run material is the least valued form of aggregate as it is unprocessed and generally used in the condition in which it's found.

Leasable Minerals

Oil and Gas

Leasable minerals include oil and gas and geothermal energy. On the basis of the past exploration efforts, there are no known oil or gas resources on the forest.

The Arizona Oil and Gas Conservation Commission has a new online data viewer of all oil and gas wells drilled in Arizona. The website is http://welldata.azogcc.az.gov/. This site was reviewed for past exploration for oil and gas on the Coconino NF.

There was an environmental analysis in 1998 to evaluate the development of oil and gas in the area of Mint Springs on the Mormon Lake Ranger District (Flagstaff Ranger District) in response to an expression of interest (USDA Forest Service 1998); however, the Bureau of Land Management never offered the oil and gas lease. It was an anomalous occurrence because on the basis of the past exploration efforts, there are no known oil or gas resources on the forest.

Geothermal Resources

Potential geothermal resources are present on the forest in two areas: the first is associated with geologically recent volcanics of the San Francisco and Mormon Mountain Volcanic Fields, and the second is associated with geothermal waters near Montezuma Castle National Monument and at the Verde Hot Springs. The San Francisco Peaks area is classified by the U.S. Geological Survey as prospectively valuable for geothermal steam (Duffield et al. 2000, Morgan et al. 2003, Morgan et al. 2004). Geothermal resources of the Verde Hot Springs and Montezuma Castle area have not been extensively evaluated from the brief literature search conducted for this analysis.

There have been previous geothermal leases on the forest in the San Francisco Volcanic Field, but they were closed in 1989. A geothermal nomination was proposed in the Eastern San Francisco Volcanic Field in 2008 and 2009 (Sierra Geothermal Power 2009, USDA Forest Service 2008b), but no leasing analysis has been conducted to date, because the lands where recent geothermal interest has been expressed are in an area of very high density of heritage sites. It also is near to the Sunset Crater Volcano National Monument and other mountains of cultural significance to the tribes. The forest did not conduct a leasing analysis and the geothermal nomination was closed. There has been no further interest since then.

Geothermal Leasing in the Western U.S., Programmatic EIS

The following information is presented as it may have future relevance to geothermal leasing analysis on the forest.

In response to the Energy Policy Act of 2005, the Bureau of Land Management and the Forest Service in cooperation with the Department of Energy prepared a Programmatic Environmental Impact Statement (PEIS), for Geothermal Leasing in the western United States (USDI Bureau of Land Management 2008a; 2008b). One purpose of the PEIS was to provide the Forest Service with a framework to facilitate pending geothermal lease applications and future determinations for projects on NFS lands. The PEIS developed a comprehensive list of stipulations, best management practices, and procedures to guide future geothermal leasing and development on public and NFS lands. The Record of Decision (ROD) identified NFS land with geothermal potential as being legally open or closed to leasing. The Apache-Sitgreaves, Tonto, and Coronado National Forests were the only Arizona forests with geothermal potential considered in their analysis. The Coconino NF was not included in their analysis even though there is geothermal resource potential and there have been past geothermal leases and interest. Their analysis identified proposed acres legally closed (by law, regulations, or other authority) to geothermal leasing and available to leasing (USDI Bureau of Land Management 2008, table 2-2, figure 2-5). Examples of non-discretionary closures

on lands administered by the Forest Service and BLM include: National Monuments, Wilderness Areas, and Designated Wild and Scenic Rivers (USDI Bureau of Land Management 2008, pages 2 to 6). The ROD did not amend any forest plans. The ROD and EIS have the most use to the Coconino in their descriptions of various stipulations and best management practices that the authorized officer can issue to impose moderate to major constraints on use of the surface of any leases to mitigate impacts to resources or desired conditions as defined in the guiding land management plan.

Mineral Withdrawals

A withdrawal is a management tool for withholding an area of NFS land from settlement, sale, location, or entry under some or all of the general land laws, including the mining and mineral leasing law, for the purposes of limiting activities under those laws to maintain other public values in the area, or reserving the area for a particular public purpose or program. The Forest Service must apply to the Secretary of the Interior for withdrawal actions on NFS lands.

Under the 1987 plan and the current condition, lands withdrawn from mineral entry include designated wilderness areas, designated wild and scenic rivers, national historic landmarks, national register districts, one traditional cultural area, other cultural sites of significance, scenic and recreation areas, and administrative sites. For this analysis, the best available mineral withdrawal information of existing past and current mineral withdrawals was compiled and a listing of the withdrawals on the forest was developed. Key sites withdrawn include:

- San Francisco Peaks Mount Elden Recreation withdrawal, which includes: Mount Elden Environmental Study Area, Elden Pueblo, Medicine Fort, San Francisco Peaks Research Natural Area Flagstaff Watershed, Lockett Meadow Recreation Area, Snowbowl Ski Area, and Kachina Peaks Wilderness;
- Administrative sites such as: National Forest Roadside Zones, Long Valley Administrative Site, lookouts, campgrounds, and the new Red Rock Ranger Station;
- Cultural sites such as Chavez Pass Ruin and Clear Creek Ruins;
- Designated wilderness areas; and
- Verde and Fossil Creek Wild and Scenic Rivers.

Mineral withdrawals are covered in this analysis because areas of past mineral findings or potential mineral resources must be considered when reviewing areas recommended for special status in plan alternatives such as: recommended wilderness areas, eligible wild and scenic rivers, proposed geologic and botanical areas, proposed research natural areas, and areas of very high scenic integrity. If mineral resources exist, then the line officer must weigh the values of the resources that exist, understand potential conflicts, and consider whether there may be other protection opportunities to accommodate both surface resources and recovery of locatable or leasable minerals. In some cases, the best use of the site may be minerals management. If the proposed management direction for these areas is not compatible with use under the mining laws, then that finding should be presented. On the other hand, if there are no potential mineral resources and no past findings of minerals, then there are no conflicts between surface resources and mineral values.

Environmental Consequences

On the Coconino NF, past mining activities and anticipated future mining activities are likely to continue to be surface or open-pit mining of cinders, pumice, sand and gravel, crushed aggregates, gypsum, and clay. Geothermal resource development has the potential to occur in the future if economic resources exist. Disturbances associated with this type of mining include: removal of trees and surface vegetation,

displacement of surface soils, erosion and sedimentation, construction of roads, buildings, wells, pumping stations, waste water ponds, and transmission lines. Other disturbances include: equipment noise, blasting, dust, emissions from generators and engines, and noxious weed infestation and spread.

Common to All Alternatives

The alternatives were compared on the basis of how many acres could be withdrawn from mineral entry (see table 57). Existing withdrawals in all alternatives include: permanent withdrawals of areas or sites prior to 1976 and the enactment of the Federal Land Policy and Management Act; withdrawals after 1976; congressionally designated wilderness areas; San Francisco Peaks/Mount Elden Recreation Area, administrative sites, and Fossil Creek and Verde Wild and Scenic Rivers. Kachina Peaks Wilderness is within another withdrawal after 1976, and is not double counted.

Existing and new areas considered for withdrawals in all alternatives include research natural areas not in wilderness (the Rocky Gulch Research Natural Area), botanical and geological areas not in wilderness. While some of these existing special areas are already withdrawn, some existing and new special areas are not. They are analyzed as a potential future withdrawal that the forest would consider, because it would be very difficult to achieve these areas' desired conditions if mineral entry is permitted in the future.

The total of existing acres withdrawn and new areas considered for withdrawal are the lowest for alternative A and highest for alternative C. Alternative D is lower than alternative B (modified) because no new wilderness is considered. Alternative D is slightly higher than alternative A because alternative D considers one new special area, the Cottonwood Basin Geological Area.

Table 57. Existing withdrawals, new wilderness, and special areas (acres) considered for withdrawal by alternative

Areas	Alternative A	Alternative B (modified)	Alternative C	Alternative D
Existing Withdrawals	268,677	268,677	268,677	268,677
Recommended Wilderness (considered for withdrawals per plan language)[1]	0	8,733	90,852[2]	0
Existing and New Special Areas (considered for withdrawals per plan language)	4,944	5,707	5,707	5,129
Total Existing and Potential New Withdrawals	**273,621**	**283,117**	**365,236**	**273,806**
Total Forest Acres[3]	1,837,498	1,837,498	1,837,498	1,837,498
Total Forest Acres Not Withdrawn	**1,563,877**	**1,554,381**	**1,472,444**	**1,563,692**

Note: Existing and new special areas considered for withdrawal include research natural areas and special areas.

[1] Upon designation by Congress, wilderness areas would be automatically withdrawn.

[2] The 905 acres of Hackberry Wilderness that cross onto the Prescott NF are not included in this number because it does not affect the total forest acres withdrawn under alternative C.

[3] Managed by Coconino NF. Does not include lands of other ownership or experimental forest.

The consequence of pursuing any mineral withdrawal for a forest is that there may be a loss of potential mineral resources, but that loss would be thoroughly evaluated with respect to the resources at risk at the site-specific level. In implementing Forest Service policy for withdrawals, it is understood that part of the withdrawal process is to evaluate potential mineral resources and the history of mineral findings in any area considered. The future potential loss of mineral resource as a result of withdrawals cannot be quantitatively or qualitatively analyzed at the forest plan level because of the lack of specificity.

Eligible wild and scenic rivers that are classified as wild would not be available for mineral activities because it is Forest Service policy to protect their eligible status pending a suitability determination. Valid existing mineral rights would be the exception to this. No new eligible wild and scenic rivers are proposed under any alternative; therefore, there is no difference in the eligible wild and scenic rivers between alternatives and, therefore, the limitations on mineral activities to protect their eligibility also would not vary by alternative.

The areas currently withdrawn from mineral entry would be carried forward in all alternatives. The consequences of retaining existing withdrawals are that very important cultural, social, scenic, and ecological resources would be protected from locatable mineral entry.

None of the recommended wilderness, research natural areas, or special areas included in alternatives B (modified), C, and D has active locatable mining operations within their boundaries, nor past or potential future oil and gas leasable mineral activity. Therefore, these areas would have no effect on active locatable mining operations or future oil and gas leasable mineral activities. There are no common variety mineral material pits in the recommended wilderness lands considered.

None of the recommended wilderness areas, research natural areas, or other special areas were sampled or of interest to the Bureau of Mines as part of their mineral resource appraisal of the Coconino NF in their report (Lane 1992). However, potential mineral commodity and energy resources are noted for these areas in table 57 and table 58.

Uranium exploration is not anticipated on the Coconino NF, because it is not present in quantities that are technologically or economically feasible to mine.

Guidance on Mineral Development

Alternative A

The 1987 plan reiterates Forest Service policy and Federal law and regulations pertaining to locatable, leasable, and mineral materials. Many of the standards and guidelines restate Forest Service regulations and policies for locatable minerals and mineral materials, and so, they are redundant with other direction required for program management of geology and minerals resources. Additionally, the 1987 plan is outdated with respect to leasing authorities and the role of the Bureau of Land Management and Forest Service in managing these resources. The no surface occupancy stipulations proposed as a standard (1987 Plan, page 76) may be overly restrictive in that a different kind of stipulation would be sufficient to protect the resources of wildlife, soils, or scenery at a site-specific location. These stipulations would limit decisions that could come about through environmental and NEPA analyses, which may allow for more flexible responses to resource issues of wildlife habitat, soils and scenery. The consequences of implementing these standards and guidelines for locatable, leasable and mineral materials is that forest resources of wildlife, soils and scenery would be well protected from surface disturbance and that the mitigation measures and stipulations applied for locatable and leasable mineral development would be very restrictive and may limit development of mineral resources.

Alternative B (modified)

Two desired condition statements are supportive of Forest Service mineral policy to foster and encourage economically sound and stable mineral industry and are also consistent with Forest Service Locatable Minerals regulations in 36 CFR 228 in that exploration and development of minerals resources shall be conducted to minimize adverse impacts to surface and groundwater resources (FW-Minerals-DC-1, 2). These desired conditions promote mineral and mining activities meeting legal mandates to facilitate development of minerals on the forest in manners that minimize adverse impacts to surface and groundwater resources and to support the availability of mineral materials to Federal, State, county, and

city agencies where feasible. These desired conditions promote the development of minerals in a way that does not detract from maintaining or meeting other applicable desired conditions for the area. There may be short-term or long-term detractions from meeting other desired conditions in the forest plan with locatable minerals development, but because the mineral resource potential of the forest is so low, conflicts with other desired conditions are not anticipated to occur very often.

One management approach relates to guidance on development of mineral materials. It reminds managers to consider withdrawing congressionally designated areas from entry and operations for locatable minerals if withdrawal was not part of the establishing legislation for the designated areas. Another management approach protects ecological resources by reminding managers to consider incorporating best management practices and stipulations into future leases from the Final Programmatic Geothermal Leasing Programmatic Environmental Impact Statement for Geothermal Leasing in the Western U.S. or to use more current direction. A final management approach reminds managers to ensure that mineral materials are available for administrative needs before considering requests for non-administrative uses. This prioritization is consistent with Forest Service regulations at 36 CFR 228.43(4) (c); however; the forest may not meet the demand from State, County and City agencies for aggregate material because providing common variety materials is a discretionary decision and the types of resources needed may not be available in the locations or quantities desired.

Alternative B (modified) would protect cultural resources by requiring mineral operations and activities to avoid or mitigate impacts to archaeological sites or places of cultural importance to American Indian Tribes that have been determined to be eligible or may be eligible for the National Register of Historic Places (FW-Minerals-S-1). Due to the low overall mineral potential on the forest, the consequences are that there is likely to be minimal overlap between mineral development and mineral material sites and archaeological or cultural sites, so the overall impact to minerals is low.

In addition, design features, such as occupancy restrictions, mitigation measures, and operating plan requirements, would be employed to minimize adverse effects from mineral activities to important wildlife and plant habitats, visually sensitive areas, archaeological sites, places of cultural importance to American Indians, and areas with large capital investments (FW-Minerals-G4). These design features would result in better protection for these resources as they would limit ground-disturbing activities associated with mineral development.

There is an ongoing need for future development of common variety mineral materials and gypsum (a locatable mineral that is mined in the Verde Valley). The desired condition statements in alternative B (modified) summarize Forest Service minerals policy and development of minerals resources, while protecting important cultural sites, habitats, and scenery through consideration of mitigations and stipulations. The guidelines in alternative B (modified) create the requirement that these important areas be considered by future mineral projects. While the exact effect cannot be estimated because they provide the flexibility of determining the appropriate type of stipulation based on the specifics of the site being analyzed, these resources would have more protection than they would be under alternative A. Compliance with law and regulation is also emphasized without reiterating specific requirements. Reclamation of mine areas is also highlighted to provide for public safety and to minimize impacts to cultural and natural resources (FW-Minerals-G5). Use and development of mineral materials by the forest is also covered, and a balanced approach is described for making materials available to local agencies where feasible (FW-Minerals-DC-2).

Two guidelines (FW-Minerals-G1, -G2) focus on mineral withdrawals and leasable minerals stipulations. Instead of providing a list of sites that should be recommended for withdrawal, revocations, or modifications as alternative A does, the proposed revised plan (alternative B (modified)) provides some general criteria for considering withdrawals. Criteria include protecting social, cultural, and ecological

values and where management direction is not compatible with mineral development. This general criterion is consistent with FSM 2760 for withdrawals.

One guideline (FW-Minerals-G1) stipulates that many of the forest's research natural areas and botanical areas have not been withdrawn from mineral entry, but could be considered for withdrawal as a consequence of this alternative. This is also true with the proposed Cottonwood Basin Geological and Botanical Area. A few sites that are of great significance to the public and tribes are listed for maintenance of their existing withdrawals, specifically, Oak Creek Canyon Recreational Area and the San Francisco/Mount Elden Recreation Area. Both are already withdrawn, and alternative B (modified) proposes retaining these withdrawals.

The other guideline (FW-Minerals-G2) addresses areas that would be considered for no surface occupancy, no leasing, or other leasing stipulations for leasable minerals. This guideline's purpose as stated is to protect social, cultural, and ecological values, which would be evaluated and considered during site-specific project planning. Implementation of this guideline has the consequence of limiting activities associated with leasable mineral development, particularly geothermal resources, for which there is potential on the forest. The limiting stipulations would make developing these minerals more expensive and, in some cases, would make development of them at certain location infeasible.

Alternative C
The guidance on mineral development is the same for alternative C as alternative B (modified).

Alternative D
The guidance on mineral development is the same for alternative D as alternative B (modified).

Guidance on Appropriate Locations for Mineral Development and Rehabilitation

Alternative A
The no surface occupancy and limited surface use stipulations that are described limit decisions that could come about through environmental and NEPA analyses, which may allow for more flexible responses to resource issues of wildlife habitat, soils and scenery. The consequences of implementing this standard/guideline are that there may be conflicts between implementing the 1987 plan and the current Forest Service Minerals policy and leasing regulations. The guidance on mineral materials is consistent with Forest Service regulations, but allowing mineral sources such as rock pits to provide other uses such as snow play areas is something that can only be done in limited areas where the site meets slope and safety requirements and where snow play can be properly managed to minimize liability, risk and protect public safety. Preparation of a forestwide mined area and reclamation schedule for the forest is not consistent with Forest Service regulations and practice as reclamation is to be done concurrent with mining by the mine operator under their permit. This includes the Forest Service at active and inactive rock pits.

Alternative B (modified)
The areas listed that have potential for geothermal resources and development include parts of the San Francisco Peaks/Mount Elden Recreation Area Withdrawal, which is also considered a traditional cultural property. Strawberry Crater recommended wilderness area has possible geothermal resource potential, but it would not be available if designated by Congress as a wilderness. Very high scenic areas that are available to leasing can be considered for no leasing or no surface occupancy, but likewise, other less constraining stipulations can be used to protect resources while still consenting to leasing and would be evaluated as part of a leasing analysis of a site-specific proposal for drilling. Areas of very high cultural site density include the Volcanic Woodlands Management Area, which overlaps an area of recent geothermal interest north of Sunset Crater in O'Leary Basin, O'Leary Peak and Robinson Mountain.

Areas of very high cultural site density; high density of threatened, endangered, or sensitive species; and sensitive plant species would be protected by all the available types of stipulations and mitigation measures. These stipulations could be designed at the site-specific level to minimize ground and noise disturbance depending on the needs of the species concerned. They would also better protect historic properties that would need broader consideration to protect the resource and its setting.

One standard, FW-Minerals S1, is proposed that relates to locations for mineral development and specifically calls for avoidance or mitigation of impacts to significant heritage sites, site complexes, cultural areas and National Register sites. Due to the low overall mineral potential on the forest, the consequences are that there is likely to be minimal overlap between mineral development and mineral material sites and archaeological or cultural sites. The existing the mineral withdrawal for the San Francisco Peaks and Mount Elden Recreational Area protects a very large area of cultural importance to American Indian tribes.

Two guidelines (FW-Minerals-G3, -G4) are proposed that relate to appropriate locations for mineral development and the application of mitigation measures and stipulations for cultural areas, sensitive areas, important wildlife and plant habitats. G3 provides for protection of resources affected by potential leasable minerals and G4 applies to locatable and salable minerals (mineral materials). Both guidelines are consistent with Forest Service regulations at 36 CFR 228 Subpart A, Subpart C and leasing stipulations available for geothermal resources. Guideline FW-Minerals-G5 provides for reclamation of past and ongoing mining operations on the forest. Reclamation is required in Forest Service locatable regulations and manual direction. Reclamation of in-service use rock pits is also covered in Forest Service mineral material regulations to provide for public safety and to restore native surface vegetation to the extent practicable.

A third guideline (FW-Minerals-G3) in alternative B (modified) relates to heritage sites. It states that mineral operations and activities should avoid sites and complexes of sites that have been identified as significant by “class of properties surveys” or National Register designation. This guideline affects all mineral activities and future proposed developments. The consequences of implementing this guideline are that significant heritage sites, site complexes, and National Register sites would be better protected from impacts because the ground-disturbing activities associated with mineral development and activities would be limited. This complies with existing law and regulation. The consequences of implementing this guideline are difficult to analyze with respect to mineral potential on the forest because these areas are not identified or mapped. Due to the low overall mineral potential on the forest, however, the consequences are likely to be that there is minimal overlap between cultural sites and high mineral potential areas or rock pit sites.

Alternative C

All of the desired conditions, standards and guidelines and management approaches are the same as for alternative B (modified) so the effects of alternative C are the same except more wilderness areas are recommended in alternative C. Additional wilderness areas recommended in alternative C besides Strawberry Crater Addition, Davey’s, and Abineau include: Walker, Railroad Draw, Deadwood Draw, Cedar Bench, Black Mountain, Cimarron-Boulder, Hackberry, Tin Can, East Clear Creek, and Barbershop. Some of the additional recommended wilderness areas are also within areas classified as very high scenic integrity in alternative B (modified), so a portion of these areas would have similar effects related to mineral development as alternative B (modified).

Alternative D

All of the desired conditions, standards and guidelines and management approaches are the same as for alternative B (modified). The only difference in consequences for alternative D is that no wilderness areas are recommended. Areas classified as very high scenic integrity in alternative D (207,582 acres) include

all the areas considered in alternative B (modified) except for parts of Abineau and Davey's recommended wilderness areas (about 848 acres). The consequences for areas of very high scenic integrity and areas of high cultural site density, threatened and endangered and sensitive species, and Traditional Cultural Properties in alternative D are the same as those discussed in alternative B (modified) for FW-Minerals-G1. The Cottonwood Basin Geological Area is recommended, but does not have leasable or locatable mineral potential; thus, FW-Minerals-G1 and G3 would not apply. Alternative D considers the same RNAs as alternative B (modified) and alternative A. None of these RNA areas have leasable mineral potential and so FW-Minerals-G1 and G3 likely would not apply.

Possible Mineral Resource Opportunity Lost by Proposed or Recommended Special Status Areas

Alternative A

Alternative A, recommends three research natural areas. Two areas, West Clear Creek and the San Francisco Peaks East and West Additions, are already withdrawn from mineral entry because they are in wilderness or are within an existing large mineral withdrawal. Rocky Gulch is the single recommended research natural area that is not currently withdrawn from mineral entry (926 acres). All three areas have no past or current valid mining claims, no past evidence of mineral commodity extractions, and have low mineral potential. The consequences of implementing these three research natural areas would be that no mineral resource opportunities would be lost. The consequences of maintaining a VQO of Preservation would be that there would be no conflicts with potential mineral resource development as these areas are either already withdrawn or are in an area of low mineral potential.

Alternative B (modified)

Recommended wilderness areas, research natural areas, the geologic special area, and areas of very high scenic integrity were evaluated for past, active, or ongoing and future mineral commodity uses.

Table 58 is a summary of mineral commodity and energy resources found from the data sources consulted. Abineau has had past geothermal resources interest, but as part of the San Francisco Peaks, Mount Elden Recreational Area, it is withdrawn from mineral entry. The Strawberry Crater addition has potential mineral resources of cinders, decorative stone, and geothermal resources. There is no location specified in the data sources consulted except for that geothermal interests were in the southwestern portion of the existing and recommended wilderness. Davey's, Cottonwood Basin Geological and Botanical Area, West Clear Creek RNA, Rocky Gulch RNA, and San Francisco Peaks RNA addition have low mineral potential. Most of the areas mapped as very high scenic integrity appear to have low mineral potential except for 13 Mile Rock Pit and the Strawberry Crater addition.

The consequences of implementing this alternative are that potential geothermal resources and saleable mineral materials could be lost from potential development in the area of the Strawberry Crater Wilderness addition; and for the 13 Mile Rock Pit, any future development would be restricted within areas having very high scenic integrity and that would mean a loss of aggregate resources. Wildlife, heritage resources, and scenic resource would have more protection from disturbance by mineral development, but the magnitude of this effect would likely be small because there is very little foreseeable development of minerals on the forest, except for geothermal resources.

Table 58. Alternative B (modified), mineral commodity or energy resources in recommended wilderness or other special area status

Area	Acres	Mineral Potential, How the Commodity is Managed, and Withdrawal Status
Recommended Wilderness		
Abineau	415	Geothermal (leasable), Pumice. Withdrawn because in San Francisco Peaks, Mount Elden Recreational area
Davey's	1,739	Low potential[1]
Strawberry Crater Addition	6,579	Cinders, Decorative stone, (likely saleable) Geothermal (leasable)
Sub Total Acres	8,733	
Special Areas		
Cottonwood Basin Geological and Botanical Area	763	Low potential
West Clear Creek Research Natural Area	769	Low potential. Withdrawn because in designated wilderness.
Rocky Gulch Research Natural Area	926	Low potential
San Francisco Peaks Research Natural Area Addition	141	Low potential. Withdrawn because in designated wilderness.
Sub Total Acres	2,458	
Total Acres	11,191	

Sources: LR 2000 Mining Claim Geographic Reports, 2-14-2011; Lane 1992; Keith et al. 1983; Welty 1989; Coconino Rock Pit sources for FPR 2011; USDA Forest Service Forest Rock Pit Inventory (USDA Forest Service 1995b); Coconino-Kaibab Rock Pit NEPA geodatabase 2011; Pits shape file 2005; Wolfe and Light 1984.

[1] Low potential means that there are no known potential mineral sources in the area and no interest has been expressed by industry. This applies to table 59 as well.

Because mineral extraction may be inconsistent with desired conditions or other plan direction for these areas, consequences to mineral resources include the loss of the potentially economically valuable mineral resources within lands recommended for wilderness, proposed for research natural area special area designation, or managed for very high scenic integrity. Valuable mineral resources that could be lost include locatable, leasable, and saleable mineral materials. The mineral resource review of areas of recommended wilderness, special areas, eligible wild and scenic rivers and very high scenic integrity found that there is low to no resource potential in these areas and that existing rock pits were assigned a low to very low scenic integrity level and so could be used with mitigations such as vegetation screening and reclamation plans. The conclusion is that very little mineral resources would be lost by proposed new wilderness or special status areas in this alternative.

Alternative C

Some of the recommended wilderness areas in alternative C have had past geothermal resource interest and others have had past placer and lode mining claims. However, the geothermal interest has waned and the there are no current mining claims in any of the recommended wilderness areas. Walker Mountain, Cedar Bench and Hackberry recommended wilderness areas have closed placer and lode mining claims that were located at various times in the 1950s through the 1980s. The future potential for leasable, salable, and locatable minerals activity is low in these areas. One inactive rock pit is located just outside the Black Mountain recommended wilderness area. Future use would have to occur outside of the recommended wilderness boundary and that may constrain future development or expansion. The consequences are that future designation of any of these the recommended wilderness areas could limit

leasable, locatable and salable mineral entry but the overall mineral potential is low so that the potential mineral resources lost is also low.

The consequences of alternative C is that ongoing or new leasable or mineral materials activities would not be considered in recommended wilderness, special areas, and research natural areas because it would be inconsistent with their desired conditions and other standards or guidelines. Salable mineral materials are also a valuable resource and existing active or proposed rock sources may be lost to future use upon designation of wilderness, new special areas, and research natural areas because mineral material management may be inconsistent with desired conditions or other guidelines. The mineral resource review of areas of recommended wilderness, special areas, eligible wild and scenic rivers, and areas of very high scenic integrity found that there is low to no resource potential in these areas and that existing rock pits were assigned a low to very low scenic integrity level and so could be utilized with mitigations such as vegetation screening and reclamation plans. The conclusion is that very little mineral resources would be lost by proposed new wilderness of special status areas in alternative C.

Alternative D

The consequences for alternative D are largely the same as alternatives A and B (modified) and accompanying discussions, except that the Cottonwood Basin Geological Area is recommended (185 acres). Because no new wilderness areas are recommended and one geological area is recommended, alternative D will leave slightly less area (185 acres) on the forest open to mineral entry for locatable, leasable and mineral materials. The two alternatives are basically the same because the proposed geological area does not have past indications of mining claim interest and has low locatable or leasable mineral resource potential. These factors may limit the need for a mineral withdrawal. Areas of very high scenic integrity are about the same as for alternative B (modified), so the effects on possible mineral resources lost due to scenery constraints are much the same as alternative B (modified).

Current and Potential New Mineral Withdrawals

Alternative A

With respect to the mineral withdrawals, various specific sites were recommended in the 1987 plan. However, all of them individually need to go through the mineral withdrawal process, which includes NEPA analysis. There could be unknown issues and concerns with sites that would factor into the withdrawal process, including mineral potential. Also, the decision to proceed with a withdrawal and the NEPA analysis for individual withdrawals would consider whether a withdrawal is warranted or whether existing law and regulation or other alternatives to withdrawals provide adequate protection of the resources.

Under this alternative, existing areas withdrawn total 268,677 acres, and existing and proposed new special areas that could be withdrawn total 4,944 acres. This acreage is the lowest of all the alternatives (table 57). There would be no conflicts between the recommended research natural areas (1,981 acres) and potential mineral resource development because two areas are already withdrawn from mineral entry and one area has low mineral potential. There would also be little conflict between the existing special areas as well, because one is already withdrawn from mineral entry (Fern Mountain) and the others (Old Caves, Griffith Springs, Rocky Gulch, Verde Valley and Mogollon Rim) have no active mining claims and low mineral potential. Red Mountain geological area, was once withdrawn from mineral entry, but the withdrawal expired in 2003, and may have geothermal resource potential. Future withdrawal of the geological area could result in a loss of geothermal resources.

There are 11 eligible wild and scenic river segments. Alternative A does not specifically recommend any of the eligible wild and scenic rivers for mineral withdrawal. However, eligible wild and scenic river segments classified as wild would not be available for new mineral activities because it is Forest Service

policy to protect their eligible wild status pending a suitability determination. These are: Barbershop Canyon, Sycamore Creek, West Clear Creek, West Fork Oak Creek, and Wet Beaver Creek. Valid existing mineral and leasing rights and existing salable mineral permits are the exception to this.

Eligible wild and scenic river segments classified as scenic or recreational are open to locatable, leasable and salable mineral exploration, prospecting, and development. These are: East Clear Creek, Leonard Canyon, Oak Creek, Upper Verde River, West Clear Creek, and Wet Beaver Creek. These would be subject to regulations that minimize surface disturbance, water sedimentation, pollution, and visual impairment per 16 U.S.C § 1280(a)(i), 36 C.F.R. 228. Withdrawal of any portion of a designated scenic or recreational river from U.S. mining and/or mineral leasing laws must be done via subsequent site-specific NEPA. East Clear Creek is the only eligible segment that overlaps with a mineral district and has past resource interest. The area of overlap with the Long Valley-Blue Ridge Claims is very small and the mineral resource potential currently is low because the surface deposit of manganese is small and not economical to mine.

All the other eligible wild and scenic rivers have no current mining claims and no known mineral resources and an overall low mineral potential. In addition, Oak Creek, Sycamore Creek, and West Fork Oak Creek are partially to largely withdrawn from mineral entry where they overlap with the Red Rock Secret Mountain Wilderness. Both segments of West Clear Creek are partially to largely withdrawn from mineral entry where they overlap with the West Clear Creek Wilderness. Both segments of Wet Beaver Creek are partially to largely withdrawn from mineral entry where they overlap with the Wet Beaver Creek Wilderness. Consequently, there would be no impact to eligible wild and scenic rivers from plan direction in alternative A regarding mineral withdrawal.

Alternative B (modified)

Alternative B (modified) recommends 8,733 acres of additional wilderness, a new special area, (Cottonwood Basin Geological and Botanical Area of 763 acres), and three research natural areas (totaling 1,981 acres). The total area of these proposed areas is 11,332 acres. The total area that could be considered for withdrawal is 10,007 acres because Abineau recommended wilderness area, West Clear Creek Research Natural Area, and the San Francisco Peaks Research Natural Area Addition are already withdrawn (table 58). Alternative B (modified) would also consider the following areas for withdrawal for locatable minerals: properties with a significant Forest Service investment in facilities, traditional cultural properties where historic preservation laws alone do not adequately protect the cultural resource, and habitat of species have a very limited range and specific habitat requirements not found elsewhere where law and regulation do not adequately protect the resource (FW-Minerals-G-1). The acreage of these last three areas is not known and is additive to the acreage above. There is a potential loss from these withdrawn acres, which is greater than alternatives A and D, but less than alternative C. There is a potential loss of mineral resources from these acres should the acres be withdrawn following site-specific NEPA analysis. The extent and magnitude of loss is not known because it is dependent on site-specific information such as how these areas overlap with potential mineral resources and history of mineral findings.

Alternative B (modified) would have the same impact to eligible wild and scenic rivers from plan direction regarding mineral withdrawal as alternative A.

Alternative B (modified) has guidelines not found in alternative A regarding protecting social, cultural, and ecological values from impacts associated with leasable minerals (geothermal resources and oil and gas). One guideline states that the following areas should be considered for no surface occupancy, no leasing, or other leasing stipulations: designated and eligible wild and scenic rivers, research natural areas and geological and botanical areas not located in wilderness, the foreground of State scenic roads, national All-American roads, and national trails; areas of very high scenic integrity not located in

designated and eligible wild and scenic rivers, or other withdrawals; San Francisco Peaks/Mount Elden Recreation Area withdrawal, areas of very high archaeological site density (greater than 60 sites per square mile) and potentially eligible for the National Register of Historic Places; areas with federally threatened or endangered, or Forest Service sensitive species; and traditional cultural properties where historic preservation laws alone do not adequately protect the cultural resource (FW-Mineral-G-3). There is a potential loss of mineral resources from these areas should they be so restricted following site-specific NEPA analysis. The extent and magnitude of loss is not known because it is dependent on site-specific information such how these areas overlap with potential mineral resources, history of mineral findings, and whether there are alternate ways to access the mineral resources besides these areas of concern.

Another guideline would protect important wildlife and plant habitats, visually sensitive areas, archaeological sites, places of cultural importance to American Indians, and areas with large capital investments through surface occupancy restrictions, mitigation measures, and operation plan requirements on mineral activities (FW-Mineral-G-4). The extent and magnitude of impact to and potential loss of mineral resources is not known because it is dependent on site-specific information such how these areas overlap with potential mineral resources, history of mineral findings, and whether there are alternate ways to access the mineral resources besides these areas of concern.

Alternative C

Alternative C would have the same effects as alternative B (modified) except for the following. Alternative C recommends 91,758 acres of additional wilderness as well as the Cottonwood Basin Geological and Botanical Area and the same three research natural areas as alternative B (modified). The total area of these new proposals is 94,357 acres. The total area that could be considered for withdrawal is 93,032 acres because Abineau, West Clear Creek Research Natural Area, and the San Francisco Peaks Research Natural Area Addition are already withdrawn (table 59). Alternative C would consider more acres of potential mineral withdrawals than any of the other alternatives because recommended wilderness could be considered for withdrawal prior to congressional designation.

Table 59 summarizes the mineral commodities and energy resources present within the various recommended wilderness areas from the data sources consulted. The consequences are the same as for alternative B (modified), but with the following additional consequences. The Abineau, Strawberry Crater, and Hackberry recommended wilderness areas have potential geothermal leasable mineral potential. Abineau is already withdrawn from mineral entry as part of the San Francisco Peaks /Mount Elden Recreational Area. The other two areas are not withdrawn, and if future geothermal interest occurs, guideline FW-Minerals-G3 would apply. East Clear Creek has manganese minerals, but no economic potential for development, so there would be no loss of valuable minerals if designated as a wilderness area. Hackberry and Cedar Bench recommended wilderness areas have past active mining claims for flagstone and possibly gold, but no past mining or current claim interest, so the future potential for saleable and locatable mineral activity is considered low in these areas. Designation of these areas as wilderness would, therefore, not result in a loss of mineral resources.

Table 59. Alternative C, mineral or energy resources in areas proposed for wilderness designation or other special area status

Area	Acres	Mineral Potential, How the Commodity is Managed, and Withdrawal Status
		Recommended Wilderness
Abineau	415	Geothermal (leasable), Pumice. Withdrawn because in San Francisco Peaks, Mount Elden Recreational area
Davey's	1,739	Low potential
Strawberry Crater Addition	6,579	Cinders, Decorative stone, (likely saleable) Geothermal, (leasable)
Walker Mountain	6,377	Flagstone (likely saleable)
Hackberry	25,836[1]	Flagstone (likely saleable); gold (locatable)
Black Mountain	9,715	Cinders, Basalt Aggregate (saleable)
Cedar Bench	5,782	Flagstone (likely saleable)
Tin Can	3,905	Low potential
Cimarron-Boulder	15,124	Low potential
Deadwood Draw	11,775	Low potential
East Clear Creek	1,986	Manganese (locatable)
Barbershop	1,305	Low potential
Railroad Draw	1,220	Low potential
Subtotal acres	91,758	
		Special Areas
Cottonwood Basin Botanical and Geological Area	763	Low potential
West Clear Creek RNA	769	Low potential. Withdrawn because in designated wilderness.
Rocky Gulch RNA	926	Low potential
San Francisco Peaks RNA Addition	141	Low potential. Withdrawn because in designated wilderness.
Subtotal Acres	2,599	

Sources: LR2000 Mining Claim Geographic Reports, 2-14-2011; Lane 1992; Keith et al. 1983; Welty 1989; Coconino Rock Pit sources for FPR 2011; USDA Forest Service Forest Rock Pit Inventory (USDA Forest Service 1995b); Coconino-Kaibab Rock Pit NEPA geodatabase 2011; Pits shape file 2005; Wolfe and Light 1984.

[1] This number includes 905 acres of Hackberry Wilderness that crosses onto the Prescott NF.

Areas classified as very high scenic integrity in alternative C (247,494 acres) include all the areas considered in alternative B (modified) plus all of the recommended wilderness areas. The consequences for high scenic areas and areas of high cultural site density, threatened and endangered and sensitive species, traditional cultural properties in alternative C are the same as those discussed in alternative B (modified) for FW Minerals-G1.

Alternative C would consider more acres of potential mineral withdrawals than any of the other alternatives (94,502 acres). This is because recommended wilderness could be considered for withdrawal prior to congressional designation.

Alternative D

Alternative D would consider slightly more acres of potential mineral withdrawals (5,129 acres) than alternative A (4,944 acres), but much less than alternative B (modified) and alternative C, because no

wilderness areas are recommended and only the small Cottonwood Basin Geological Area is proposed. The difference is 185 acres.

Cumulative Effects, All Alternatives

The cumulative effects timeframe for the minerals and energy analysis is for the next 10 to 15 years. The spatial extent includes the forest and the local communities within and closely adjacent to the forest boundary. The demand for minerals and energy resources on the forest is influenced by external factors such as the economy and public demand for these resources, as well as nearby construction and development. These factors and past trends are considered in evaluating cumulative effects for energy and minerals.

Several categories of factors can contribute to cumulative effects: plans, such as land and resource management plans; recovery plans, including safe harbor agreements, conservation agreements, and similar action plans; ground-disturbing activities, such as mines, urban development, and fire suppression. The cumulative effects of these plans range from positive to negative, depending on how the management of mineral resources on neighboring lands relates to the management of those resources on the forest.

American Indian Tribes

The Hopi Tribe's Hopi Woodland Management Plan includes objectives to protect wildlife habitat, watersheds, and threatened, endangered, and culturally sensitive species. The plan also includes objectives protect and restore riparian areas and to prevent the invasion of noxious weeds. The Hualapai Reservation's Hualapai Fire Management Plan includes goals to maintain water quality. The Hualapai Reservation also has Watershed Management Plans designed to improve water quality in the Colorado River. The Tribe is also actively managing endangered native fish. These plans will guide the location and development of mineral resources, if any, on the Hopi and Hualapai reservations. Together, the management of mineral and other resources is enhanced by the cumulative management of mineral resources by the Tribes and the Coconino NF. These combined management efforts should positively contribute to wildlife habitat, watersheds, riparian areas, and threatened, endangered, and culturally sensitive species on the Coconino NF.

Department of Interior – National Park Service

The Coconino NF is adjacent to or near six national monuments: Walnut Canyon (3,251 acres), Sunset Crater Volcano (3,040 acres), Wupatki (35,402 acres), Montezuma Castle Montezuma Well (999 acres), and Tuzigoot (366 acres). The lands in these national monuments are withdrawn from mineral location, leasing, and entry under public land laws. The Coconino NF currently has 268,677 acres withdrawn from mineral entry. Depending on whether an alternative would create or recommend new wilderness or special areas, the number of acres could increase as follows: alternative A – 273,621 acres, alternative B (modified) – 283,117 acres, alternative C – 365,236 acres, and alternative D – 273,806 acres. These designations would impact mineral resources by closing areas to new mineral location, leasing and mineral materials pits and any closing existing materials pits within the wilderness would be closed once they are depleted or no longer needed. Cumulatively, alternative C would have the greatest effect to mineral resources (408,294 acres), followed by alternative B (modified) (326,175 acres), alternative D (316,864 acres), and alternative A (316,679 acres).

Department of Agriculture – Forest Service

Similar forest planning efforts have been completed on three neighboring national forests: the Kaibab, Prescott, and Apache-Sitgreaves NFs. All of these forests have revised their land management plans based upon the same regional vegetative desired conditions for ecological response units found in the Southwest Region. These final revised plans were used to determine interactions between guidance found in the

Coconino NF's proposed plan. No conflicts were found in the final revised plans for these forests. The Tonto NF is in the process of revising its forest plan; it will also incorporate the regional vegetative desired conditions. All of these forests are guided by the same laws, regulations, and policies as the Coconino NF. The plans for all of these forests will guide the location and development of mineral resources, if any. The management of mineral and other resources is enhanced by the cumulative management of these forests and the Coconino NF. These combined management efforts should positively contribute to conditions on the Coconino NF.

The final revised plans for the Kaibab, Prescott, and Apache-Sitgreaves NFs include recommendations to designate 25,630 acres of these forests as wilderness (Kaibab – 6,400 acres, Prescott – 12,130 acres, and Apache-Sitgreaves – 7,100 acres). This would be in addition the 242,553 acres that are already designated as wilderness on these forests (Kaibab – 114,839 acres, Prescott – 104,480, and Apache-Sitgreaves – 23,234 acres). Alternative B (modified) recommends 8,733 acres for wilderness designation and alternative C recommends 91,757 acres for wilderness designation. This would be in addition to the 156,374 acres that are already designated as wilderness on the Coconino NF. Alternatives A and D do not recommend any acres for wilderness designation. If any of the areas recommended as wilderness areas are designated as wilderness, they would become closed to new mineral leases and new mineral materials pits, and any existing materials pits within the wilderness would be closed once they are depleted or no longer needed. Cumulatively, alternative C includes that most acres that could impact mineral entry across these forests (117,387 acres), followed by alternative B (modified) (34,093 acres), and alternatives A and D (25,630 acres).

It is likely that there would be increased interest in geothermal exploration and development on the forest, particularly with the promotion of renewable energy sources by energy companies, and State and local government policies and incentives. The Coconino NF would work cooperatively with the Bureau of Land Management in evaluating any nominations or leasing proposals for geothermal resources. Exploration for uranium and future development of it may continue on the Kaibab and Tonto NFs; however, it would not be likely to affect the environment of the Coconino NF. Uranium exploration is not anticipated on the Coconino NF due to the lack of economic resources.

The anticipated uses of mineral materials for road aggregate and other uses on the forest is anticipated to increase as forest products companies start up, forest restoration projects get underway, and when planning efforts like the Four-Forest Restoration Initiative are completed. The Coconino-Kaibab Rock Pit Final Environmental Analysis will allow use and develop 18 rock pits on the forest, as well as reclaim two rock pits. Twenty existing and new rock pits are proposed for use on the Kaibab National Forest. Most of the rock would be used by the Coconino and Kaibab National Forests, but some may be made available and sold to counties, cities, and other agencies for use. It is anticipated that as road management agencies, such as Arizona Department of Transportation, implement road improvement projects within the forest, there may be requests for use and development of existing or new pits. Arizona Department of Transportation or counties' public works departments may propose to use or develop new or existing pits. This would be evaluated on a case-by-case basis and mineral materials would be made available, where it is feasible, available, and consistent with other resource values. There is also some mineral material removal on a localized basis on private land within and near the forest. Most of this takes place in the Verde Valley, but there are some locations on private land elsewhere. These mineral pits are generally not managed for their effects to other resources except concerning water quality, where they might have an effect on a flood plain or jurisdictional water.

Arizona Department of Arizona Department of Environmental Quality (ADEQ)

The State of Arizona has promulgated regulations for environmental quality. Title 49 outlines specifics such as water quality standards and total maximum daily loads. These regulations create management

outcome expectations that are similar to those envisioned on the forest. In addition, storm water pollution prevention plans are required by ADEQ for mineral materials pits and mining operations both on and off of the forest to control off-site sedimentation from the rock pit and to maintain water quality. By managing mineral resource activities on the forest and on other lands adjacent to the Coconino NF to meet water quality standards, these state regulations should result in cleaner water on the forest.

Arizona Department of Water Resources

The Arizona Department of Water Resources (ADWR) administers and enforces the State's groundwater code and surface water rights laws (Arizona Department of Water Resources 2016). The mission of the ADWR is to secure long-term dependable water supplies for Arizona. Title 45 of the Arizona Revised Statutes contains the provisions related to water and groundwater resources. By managing mineral resource activities on other lands adjacent to the Coconino NF to ensure long-term dependable water supplies, these state regulations should result in retention of ground and surface water on the forest.

Arizona Game and Fish Department

The Arizona Game and Fish Department (AZGFD) manages wildlife populations in the State. The AZGFD pursues its management under the guidance of a variety of plans. The Wildlife 20/20 Strategic Plan provides management direction for the department's program of work. The plan is built around two strategic themes: wildlife conservation and recreation (Arizona Game and Fish Department 2016). The Arizona State Wildlife Action Plan: 2012-2022 (previously titled Arizona's Comprehensive Wildlife Conservation Strategy), was approved in 2012, and provides the vision for managing Arizona's fish, wildlife, and wildlife habitats. The plan contains several key elements that may provide information for, or have an impact on, Coconino NF management:

- distribution and abundance of wildlife;
- locations and condition of key habitats and community types;
- problems that may adversely affect species in their habitats; and
- proposed conservation actions for habitats and species and implementation priorities.

This plan will assist neighboring land managers to make decisions on the location and development of mineral resources that is compatible with AZGFD's management of wildlife. The management of mineral and other resources is enhanced by the cumulative management of neighboring land managers and the Coconino NF. These combined management efforts should positively contribute to wildlife populations on the Coconino NF

Local Government

The landscape in the analysis areas has become more fragmented and altered as a result of human activities that include urban development, roads, infrastructure development, ranching, and fire suppression. Fragmentation and habitat alteration have been especially problematic in the Montane/Subalpine Grassland ERU and the cinder soils found in the Doney Park, Timberline, and similar neighborhoods in Coconino County and in the Semi-desert Grassland and Desert Communities ERUs in Yavapai County. Many local governments have addressed the growing fragmentation in their planning efforts. The Coconino County Comprehensive Plan (2015) serves as a long-range guide for the future, with goals that provide general direction, and policies that specify the location, form, purpose, and acceptable impacts of development. The environmental pillar of this plan includes ecosystem services, air quality, water quantity and quality, open space, and climate change. The Flagstaff Regional Plan (2014) adopted by the Coconino County Board of Supervisors and Flagstaff City Council includes an element

that addresses open space. The Yavapai County Comprehensive Plan (2012) covers eight topic areas: land use, transportation, water and open space, energy, environment, cost of development, and growth areas. The Sedona Community Plan (Imagine Sedona 2020 and Beyond) guides the city in, among other things, making decisions about new development and re-zonings (City of Sedona 2014). The Verde Valley Regional Land Use Plan includes open space preservation as a key component for a balanced land-use pattern (Yavapai County 2006). These plans will guide the location and development of mineral resources, if any. The management of mineral and other resources is enhanced by the cumulative management of these local governments and the Coconino NF. These combined management efforts should positively contribute to conditions on the Coconino NF.

Verde Gypsum Mine

The Verde Gypsum Mine had its patent application approved in 2011, so about 243 acres of former Coconino NF lands are now privately held lands that will be mined or used in mine operations. Parts of the mine are still on NFS land and the mineral operations remain under a plan of operations that will be updated. There is potential for the mine to expand on lands managed by the Forest Service. Mitigation measures to protect surface resources will remain applicable on NFS lands covered by any updated plan of operations. Parts of the gypsum mine that are on leased State lands or on private lands will be subject to applicable State and Federal requirements to protect air, water, and environmental quality enforced by the State of Arizona. It is anticipated that this mine will continue operations far into the future providing gypsum to local cement plants. Production may increase as the economy improves and construction and development increases. Current or expanded mineral operations of the Verde Gypsum Mine are not likely to be lost due to conflicts with special area status since is not within or near recommended research natural areas or eligible wild and scenic rivers in any alternative, it is outside and not near recommended wilderness areas in alternatives B (modified) or C, and it is not within any areas with a visual quality objective of Preservation (alternative A) or scenic integrity objective of Very High (alternatives B (modified), C, and D).

No other mineral developments on adjacent national forests would have cumulative effects when considered along with the Coconino NF's management of mineral resources.

Fire Management

For more information on fire management, see Air Quality and Vegetation and Fire sections.

This section addresses impacts of fire on communities. See the Air section for impacts from smoke.

Affected Environment

The existing condition of three ERUs (Ponderosa Pine, Mixed-Conifer with Frequent Fire, and Pinyon Juniper with Grass) would be addressed in detail due primarily to their importance to our communities and their dominance of the landscape. Uncharacteristic fire behavior in these ERUs can lead to direct loss of community infrastructure including communication, transportation, energy, and water supplies. In this discussion, uncharacteristic wildfires are wildfires with characteristics other than what fire-adapted ERUs have evolved with, e.g., larger, more intense, more severe, bigger patch sizes, or more frequent than what occurred historically. Uncharacteristic wildfires could also spread into areas like Alpine Tundra, riparian areas, or Spruce-Fir (where large high-severity fires naturally occur, but are infrequent) where specific or exceptional circumstances need to be present in order for wildfire to occur. Due to limited resources for treatments and elevated values adjacent to these ERUs, treatments have historically been accomplished almost exclusively in these three ERUs. The forest staff anticipates this trend to continue; therefore, analysis of alternatives for ERUs would be commensurate.

In an effort to identify and protect community infrastructure, the Healthy Forest Restoration Act (2003) called for preparation of community wildfire protection plans to define the wildland-urban interface and establish priorities for wildfire preparedness and hazardous fuels reduction work in these areas. Currently, the Coconino NF has two community wildfire protection plans that cover over 1,494,900 acres on Federal, State, county, and private lands. Of this, approximately 1,304,152 acres are on NFS lands. These two community wildfire protection plans are for Flagstaff and surrounding communities (GFFP and PFAC 2012) and Blue Ridge Area and Mogollon Ranger District of the Coconino NF (Gatewood and Hampton 2009). The Flagstaff Community Wildfire Protection Plan includes the following communities: city of Flagstaff, Munds Park, Kachina Village, Mountainaire, Forest Highlands, Mormon Lake, Bellemont, Timberline-Fernwood, Doney Park, Lower Lake Mary, Flagstaff Ranch, Baderville-Fort Valley, Mount Elden, Westwood, Pine Dell, Cosnino, Winona, Upper Oak Creek Canyon, and Sedona. The Blue Ridge Community Wildfire Protection Plan addresses the following communities: Starlight Pines, Clear Creek Pines, Blue Ridge Estates, Pine Canyon, Stoneman Lake, and Clints Well.

There are additional areas on the forest that meet the Forest Service Manual (Southwestern Region supplement) definition of wildland-urban interface (Region 3 supplement 5140). For the plan revision, wildland-urban interface is defined as follows:

> *Wildland-urban interface (wildland-urban interface) includes those areas of resident populations at imminent risk from wildfire, and human developments having special significance. These areas may include critical communication sites, municipal watersheds, high voltage transmission lines, church camps, scout camps, research facilities, and other structures that, if destroyed by fire, would result in hardship to communities. These areas encompass not only the sites themselves, but also the continuous slopes and fuels that lead directly to the sites, regardless of the distance involved. (FSM 5140.5)*

During the last 10 years on the Coconino NF, the overall threats to community have decreased primarily due to effective treatments in the wildland-urban interface. Areas that have experienced effective treatments (they have greatly reduced departure and increased fire resilience) in intensive wildland-urban interface tend to have relatively low threat levels. Examples of this include areas adjacent to Flagstaff and Mountainaire. However, areas that have not had effective treatments remain at relatively high threat levels. Of particular concern are those areas that (1) have not received treatment and (2) are on the intensive end of the wildland-urban interface spectrum (e.g., high value critical infrastructure, subdivisions). Threats to communities would increase over time if treatments are not maintained.

Environmental Consequences

Plan alternatives would affect the threat to community in terms of how each provides opportunity for treatment acres. In other words, the greater the treatment opportunity, the lower the threat of wildfire to communities. This threat is assessed, independent of ERU, because the vegetation is simply fuel as it relates to values. The following analysis considers the effects of the alternatives on management of fire in wildland-urban interface areas, wilderness areas, and forestwide fire management.

Wildland-urban Interface

Common to All Alternatives

All alternatives provide direction for fuels reduction treatments and maintenance of vegetation for those areas of resident populations at imminent risk from wildfire, as well as human developments having special significance (1987 Plan, page 93; FW-WUI-DC-2). These wildland-urban interface areas encompass not only the sites themselves, but also the continuous slopes and fuels that lead directly to the sites regardless of the distance involved.

Overall, trends for vegetation as it relates to fire and fire severity would improve under all alternatives in ponderosa pine and mixed conifer with frequent fire ERUs. A trend toward desired conditions means the ecological system is moving toward characteristic fire, including a reduction in severity and a reduction in the risk of uncharacteristic fire (FW-TerrERU-PP-O-1, 2, and 3).

Alternative A

Like the other alternatives, the current plan promotes reducing threats of uncharacteristic fire on departed vegetation types (1987 Plan, pages 65-2, 65-3, 65-4, 65-5, 65-11, 94, 95, 96, 186, 206-11, 206-114, 206-75, 206-77).

However, the forest has placed a strong emphasis on wildland-urban interface treatment since about 1998. This is particularly evident on NFS lands adjacent to Flagstaff. The wildland-urban interface areas with the highest values-at-risk are the highest priority for any mechanical or fire treatment (preferably both) that reduces future (0 to 10 years) fire intensity and severity because damage to or loss of their values-at-risk (e.g., life, property, water supply, water treatment, communication towers) would threaten or cause harm to the communities.

Alternative A lacks an emphasis on fire restoration. In addition, alternative A does not allow wildfires managed for resource objectives within wildland-urban interface areas (1987 Plan, pages 93, 137, 144, 147, 155, 157, 161, 170, 182). This language negatively affects restoration efforts because it is one less tool that could be used to reduce the risk of uncharacteristic fires. As a result, it is expected that fewer acres would be treated within wildland-urban interface areas. Therefore, there would be a higher likelihood that the vegetation within the wildland-urban interface areas would have greater tree density and would experience higher fire severity and intensity than is desired. Furthermore, if a wildfire moved into the area surrounding communities under severe fire weather conditions, it could be difficult to suppress; would require more resources, may increase the risk to firefighters; and could put people, property, and infrastructure at greater risk.

Alternative B (modified)

This alternative also clearly articulates the need to create and maintain the most resilient and least volatile forest composition and structure within the wildland-urban interface areas (FW-WUI-DC-2, 3, 4, 5, 6, 7, 8, 9). This more resilient condition would take the form of relatively open stands with lower tree densities and fuel loads, but still be within desired conditions (FW-WUI-G-1). In contrast to alternative A, , alternative B (modified) lacks the constraints on using wildfires managed for resource objectives in wildland-urban interface and emphasizes restoring fire to fire-adapted ERUs (FW-TerrERU-All-DC-2, FW-TerrERU-IC-DC-3, FW-TerrERU-PJ-DC-3, 4, FW-TerrERU-AspMpl-DC-2, FW-TerrERU-PP-DC-3, and FW-TerrERU-MC-MCFF-DC-5). Unlike alternative A, plan language in alternative B (modified) supports the use of prescribed fire and wildfires that meet resource objectives in wildland-urban interface areas (FW-Fire-G-1 and 2, and FW-Fire-Management Approaches). This could result in more acreage treated by wildfires managed for resource objectives, lower fire intensities and severities, and greater protection to communities and values-at-risk in wildland-urban interface areas provided this is where treatments occur.

Although alternative B (modified) generally allows for more fire treatment (prescribed fire and wildfires managed for resource objectives) acres within the wildland-urban interface, having wildland-urban interface located next to an existing or recommended wilderness can increase uncertainty and increase the chances of a decision to suppress wildfires rather than manage them for resource objectives. Alternative B (modified) includes three recommended wilderness areas that total 8,733 acres. As discussed in the methods section, the decision to suppress wildfires within wilderness is based on a number of interacting factors, some of which change over time. These effects are not strictly limited to the area within wilderness, but can also affect the areas in close proximity. If a wildfire starts within wildland-urban

interface, it may be suppressed if there is a chance that the fire could move into a wilderness area where law, policy, or direction (such as prohibitions on the use of mechanical equipment) creates operational constraints that could affect the safe and successful control and management of the wildfire for resource objectives.

When a wildland-urban interface area intersects ERUs with a mixed or high-severity fire regime (such as Interior Chaparral, Pinyon Juniper Evergreen Shrub, Pinyon Juniper Woodland, Mixed Conifer with Infrequent Fire, Spruce-Fir, and some portions of Mixed Conifer with Frequent Fire), characteristic ecosystem function is modified to promote low-severity surface fires (FW-WUI-DC-8). This plan direction is a trade-off between the reducing departure from characteristic fire regimes and the potential impact on communities and other at-risk values. The trends for all of these ERUs (with the exception of Mixed Conifer with Frequent Fire and Spruce-Fir) are away from desired conditions in terms of fire return interval. The Pinyon Juniper Evergreen Shrub and Mixed Conifer Infrequent Fire ERUs are adapted to mixed-severity in which 25 to 75 percent of the dominant overstory is replaced. Interior Chaparral, Pinyon Juniper Woodland, and Spruce-Fir ERUs are adapted to high-severity fires in which over 75 percent overstory replacement is within the natural range of variability.

The consequences of this direction (FW-wildland-urban interface-DC-8) are complex. If wildfires occur within the wildland-urban interface portions of these mixed and high-severity fire ERUs and conditions are not conducive to low-severity fires, then the likelihood of a suppression response increases. Mechanical or prescribed fire pretreatment would be a critical management strategy to promote the desired condition. If pretreatment is accomplished and conditions are suitable, progress would be made toward the desired conditions even if the ERUs are departing from the natural fire regime. In the absence of mechanical or prescribed fire pretreatment, this pattern of suppression may have the effect of increasing the fire intensity and severity of future fires within wildland-urban interface areas into the higher range of (or beyond) the natural fire regime. Within wildland-urban interface areas, it may continue to move the ERU away from desired conditions and, for mixed-severity ERUs, away from historic conditions as well. While this direction could have effects within wildland-urban interface areas, is not expected to affect treatment frequency or fire return interval departure across the ERUs as a whole.

Alternative C

The plan components to manage wildland-urban interface areas would be same as alternative B (modified). The consequences for alternative C would be the similar to alternative B (modified). However, alternative C includes 13 recommended wilderness areas totaling 91,757 acres. The increase in recommended wilderness areas could increase the likelihood of a decision to suppress wildfires due to their proximity to wildland-urban interface areas. Consequently, under alternative C, it is possible that there would be fewer opportunities to manage wildfires for resource objectives and vegetation within wildland-urban interface areas, which could make slower progress toward desired conditions.

Alternative D

The plan components to manage wildland-urban interface areas would be the same as alternative B (modified). The consequences for alternative D would be the same as alternative B (modified).

Wilderness

Alternative A

Under alternative A, there are restrictions to the types of activities that can occur within designated wilderness. Some of these restrictions are based on the provisions of the Wilderness Act (1964) and some are based on the direction provided in the 1987 plan. The Wilderness Act establishes that the use of motorized equipment is not compatible with wilderness objectives, and as a result, the vegetation may not be managed through mechanical harvest activities. In general, as the proportion of each ERU that is

subject to wilderness management constraints increases, there is also a greater potential to decrease the rate at which the ERU can move toward the desired condition. However, if wildfires can be appropriately managed to meet resource objectives, then they could mitigate the effects of some of the constraints; some of the challenges associated with using this management tool are described below.

Although wildfires managed for resource objectives are not explicitly prohibited under alternative A, management direction provided by the 1987 Forest Plan makes it extremely difficult to implement wildfire treatment in the wilderness. Some examples of these constraints include maximum size limits (of 300 acres or less for seven of eight wilderness areas), a requirement to be able to contain a fire by 10:00 a.m. the following day, and pre-treating with prescribed fires prior to wildfires in areas of "unnatural fuel buildups" (1987 Plan, pages 111 to 112). These constraints have resulted in no wildfires being managed to meet resource objectives in wilderness areas on the forest since the current forest plan was signed (1987). Wildfires that occur in designated wilderness areas would generally have a greater risk of resulting in uncharacteristic fire effects, having higher than desired fire severity, and a decreased likelihood of restoring the historic fire regime and vegetation structure. Based on these constraints and the current trend in treatment within wilderness, it is expected that designated wilderness areas would trend away from desired vegetation conditions and the ERUs overall would make somewhat slower progress toward desired conditions.

Alternative B (modified)

Alternative B (modified) includes plan components that encourage disturbances, including fire and flooding, to play their natural role as a disturbance agent within wilderness areas (SA-Wild-DC-4). Other plan components promote wildland fires within historic fire regimes with the caveat that they do not result in the loss of life, property, or ecosystem function (FW-Fire-DC-2,3); encourage the restoration of desired disturbance regimes, including fire, when practical (FW-TerrERU-All-DC-2); and encourage fire management where conditions permit and where consistent with maintenance of or moving toward desired conditions for other resources (FW-Fire-G-2, Management Approaches for Fire Management) without the additional constraints found under alternative A. Consequently, despite the remaining constraints, there would be more opportunities to treat fire-adapted ERUs with fire within wilderness areas, compared to alternative A.

Under alternative B (modified), three new wilderness areas are proposed for designation. Abineau, Strawberry Crater, and Davey's recommended wilderness areas total approximately 8,733 acres and occur across eight ERUs. The majority of the proposed areas fall within the Pinyon Juniper with Grass and Great Basin Grassland ERUs (all within the Strawberry Crater Recommended Wilderness); however, the proposed areas also represent only a relatively small fraction of each ERU (1.4 percent and 2.5 percent, respectively). The effects of the recommended wilderness designation on specific vegetation and fire return interval departure is addressed within the Environmental Consequences section for each ERU.

For recommended wilderness areas, the direction under alternative B (modified) promotes the maintenance or enhancement of the primitive and undeveloped characteristics of the areas and supports reduced evidence of modern human control or manipulation (SA-RWild-DC 1 and 2). Accordingly, fire could be an appropriate tool. On the other hand, plan language for recommended wilderness constrains the use of motorized equipment (SA-RWild-DC 1 and 2), which is an important mitigation for some safety risks and in some areas would be important for pre-treatment to reduce the risk of greater than desired fire severity. However, the overall affected area is limited and represents a small fraction of each ERU (table 15).

Alternative C

The plan components related to designated and recommended wilderness areas would be the same as alternative B (modified). The consequences for alternative C would be similar to alternative B (modified).

The differences between alternative B (modified) and alternative C are related to the differing amounts of recommended wilderness between the alternatives.

Alternative C includes 10 recommended wilderness areas in addition to those included in alternative B (modified). These 13 recommended wilderness areas encompass 91,757 acres and occur across 15 ERUs. The majority of the recommended wilderness areas fall within the Pinyon Juniper Evergreen Shrub, Pinyon Juniper Woodland, and Semi-desert Grassland ERUs. The recommended wilderness areas represent anywhere between less than 0.1 percent to 19 percent of the ERUs.

Alternative C is similar to alternative B (modified) in terms of allowing for fire to play its natural role as a disturbance agent within wilderness areas (SA-Wild-DC-4) and allowing fire management without the additional constraints included in alternative A. Like alternative B (modified), recommendation of wilderness could increase coordination needs, logistical complexity (mainly access), and reduce the available fire management tools (chainsaws, ATVs, fire engines, etc.), which in some areas would be important to mitigate some risks and for pre-treatment to reduce the likelihood of greater than desired fire severity. The substantial increase in areas recommended for wilderness designation under this alternative would lead to fewer opportunities to use prescribed fire and wildfires managed for resource objectives than under alternative B (modified). The total amount of recommended wilderness area is about 10 times that of alternative B (modified). This represents a small fraction of most ERUs except for Semi-desert Grassland, Pinyon Juniper Evergreen Shrub, and Pinyon Juniper Woodland in which between 13 to 19 percent of these individual ERUs are affected. The majority of these ERU acres are in the following recommended wilderness areas: Black Mountain, Cedar Bench, Cimarron- Boulder, Deadwood Draw, Hackberry, Tin Can, and Walker Mountain.

Alternative D

Alternative D is similar to alternative A in that it includes no recommended wilderness areas. Unlike alternative A, but like alternatives B (modified) and C, alternative D would not have the plan language that adds additional constraints to the use of wildfire managed for resource objectives. As a result, under this alternative, there would be more opportunities to manage wildfires and prescribed fires to meet resource objectives than under any other alternative.

Forestwide Fire Management

Alternative A

Alternative A presents the least opportunity for implementing treatments, because it has constraints on using wildfires to meet resource objectives and a general lack of emphasis on the ecological need of frequent fire. Alternative A explicitly prohibits the use of wildfires with resource objectives in the wildland-urban interface and Oak Creek Canyon and limits its use in wilderness (1987 Plan, pages 92 to 94).

Alternative B (modified)

Alternative B (modified) makes managing wildfires for resource objectives more probable (forestwide) by having clear objectives that are consistent with fire treatment (FW-TerrERU-PP-O-3, FW-TerrERU-PJ-O-2 and 3). Furthermore, this alternative has a guideline (FW-Fire-G-2) that encourages the use of fire to move ERUs toward desired conditions. In addition, there are forestwide management approaches that emphasize fire treatment planning and implementation (Fire Management – Management Approaches). In contrast, alternative A lacks substantial emphasis on the natural role fire plays in restoring and maintaining the composition, structure, and function of fire-adapted ERUs. Ultimately, the amount that the threat of uncharacteristic fire is reduced depends on the frequency of treatments, the location of the wildfire (relative to the community or specially designated areas), the size of the treated areas, and the effectiveness or level of treatment (how much these treatments reduce vegetation, modify the fuels profile, and reduce volatility).

Alternative C
The plan components related to forestwide fire management would be same as alternative B (modified). The consequences for alternative C would be the similar to alternative B (modified).

Alternative D
The plan components related to forestwide fire management would be the same as alternative B (modified). The consequences for alternative D would be the similar to alternative B (modified).

Cumulative Effects

Cumulative effects are the consequences of past and foreseeable activities on Federal and non-Federal lands that, in conjunction with direct or indirect effects from management activities likely to occur on the forest, may intensify, negate, improve, or otherwise affect the vegetation types, habitats, and species of the forest. The geographic setting for the cumulative effects analysis includes all lands within the forest boundary and lands that are immediately adjacent to the forest boundary (e.g., some lands administered by the State of Arizona, the Walnut Canyon National Monument, and adjacent national forests). The timeframe for past actions is 20 years and 10 years for future and foreseeable projects.

Past vegetation growth, previous management and disturbance patterns, and annual weather patterns have contributed to the current conditions of vegetative composition and structure. Past vegetation management actions (including a lack of action) that are still contributing to current conditions include fire suppression, the lack of thinning in small and medium-sized trees, and a history of even-aged silvicultural treatments. These have resulted in an overabundance of smaller trees, uncharacteristic wildfires, and a general deficit of large and old trees.

Recent past and present vegetation management actions on the forest have focused mostly on reducing hazardous fuels and restoring ponderosa pine forests toward the full range of historic variability. The 1996 Forest Plan Amendment (USDA Forest Service 1996a) and adoption of the Northern Goshawk Recommendations (USDA Forest Service 1992a) have resulted in a shift toward more uneven-aged silvicultural systems. The use of prescribed burning has been analyzed in most vegetation treatment environmental analyses, allowing for the reintroduction of fire into fire-adapted ERUs. However, these relatively recent changes have generally not been sufficient to completely reverse the departure of vegetation and fire return interval created by past actions.

Several national forests in the immediate vicinity of the Coconino NF have revised or are in the process of revising their forest plans. All have placed an emphasis (or there is a reasonable expectation that they will) on the restoration of plant communities (ERUs). Activities associated with the new plans are expected to maintain or make progress toward desired conditions that are similar across the Southwestern Region; these activities include uneven-aged silvicultural treatments that ensure that all ages and sizes of trees are present throughout the landscape and fire treatments that reduce the potential for uncharacteristic fire behavior. Cumulatively, they would also promote a structure, composition, and pattern that is similar to historic conditions and promote resilience to disturbances like insect outbreaks, wildfires, and a changing climate.

The National Park Service General Management Plan for the Walnut Canyon National Monument authorizes mechanical thinning to reduce tree densities and prescribed fires to restore fire to its natural role in ponderosa pine stands. When implemented, these activities would reduce the risk of uncharacteristic fires and help restore the structure, composition, and function of vegetation communities. Similarly, the Arizona state forestry division is expected to continue implementing mechanical and fire treatments that reduce tree density, restore the local vegetation structure and pattern, and reduce the risk of uncharacteristic fires (especially in the wildland-urban interface areas). Community wildfire protection plans emphasize treatments across multiple jurisdictions including, Federal, State, county, and private

lands that are within the wildland-urban interface areas; as a consequence, the risk of uncharacteristic wildfires to communities would be reduced.

The Four-Forest Restoration Initiative is a planning effort designed to restore ponderosa pine forest resiliency and function across four national forests in Arizona including the Coconino, Kaibab, Apache-Sitgreaves, and Tonto NFs. The initiative area has been divided into multiple environmental analyses including at least two large analyses. The first large analysis has been completed and covers over 980,000 acres spanning both the Coconino and Kaibab NFs. Within this area, a suite of restoration treatments, including mechanical and fire treatments, have been analyzed on approximately 230,000 acres of the Kaibab NF and 355,000 acres of the Coconino NF. The second large analysis is currently underway and is expected to analyze treatments that would restore the resiliency and function of ponderosa pine forests that span the southern portion of the Coconino NF and portions of the Apache-Sitgreaves and the Tonto NFs. The restoration treatments occurring on three nearby national forests are expected to support and improve the positive outcomes of treatments on the Coconino NF by increasing the scale of restoration and reducing the vegetation and fire return interval departure across a larger landscape.

Based on the revisions (or expected revisions) to the forest plans of neighboring national forests and the anticipated activities throughout adjoining lands, there are no anticipated negative cumulative effects to vegetation and fire return interval. Rather, it is expected that the cumulative environmental consequences, in the context of the surrounding area, would be either neutral to or would improve the identified trends of vegetation and fire return interval departure for all alternatives.

Forest Products

Analysis related to forest products may also be found in the Vegetation and Fire section, Socioeconomic section, and appendix E: Other 1982 Planning Rule Provisions. Methodology and other background information related to forest products may be found in appendix G: Timber Sale Schedule, Financial Evaluation, Allowable Sale Quantity, Long-term Sustained Yield, and Timber Suitability Calculation.

Affected Environment

Forest products fall into three categories: (1) timber, (2) special forest products, and (3) forest botanical products. Timber products include products such as firewood, wood pellets for home and industrial heating, structural panels, animal bedding, wood molding, pallets, structural lumber, posts and poles, sawtimber, pulpwood, non-sawlog materials removed in log form, cull logs, small roundwood, house logs, and biomass for electricity. Special forest products include products such as bark, berries, boughs, bryophytes (i.e., nonvascular plants such as mosses), bulbs, burls (i.e., deformed tree growths), cactus, Christmas trees, cones, ferns, firewood, forbs, fungi (including mushrooms), grasses, nuts (including pinyon nuts), pine straw, roots, sedges, seeds, transplants, tree sap, wildflowers, fence material, mine props, posts and poles, and rails. Forest botanical products are a subset of special forest products, but exclude timber products such as Christmas trees, firewood, fence materials, mine props, rails, posts, and poles. Forest products do not include rocks, minerals, animals, animal parts, insects, worms, soil, or water.

Lands Tentatively Suitable for Timber Production

Timber production is the purposeful growing, tending, harvesting, and regeneration of regulated crops of trees for cutting into logs, bolts, or other round sections for industrial or consumer use. Timber production does not include timber removed from unsuitable lands as part of a vegetation treatment. Timber production also does not include firewood or products harvested from unsuitable lands. Lands were identified as suitable or not suitable for timber production during the plan revision process. Appendix G details the steps used in the timber suitability determination. The Coconino NF has approximately

613,251 acres considered tentatively suitable for timber production. Suitable timberland does not dictate tree cutting. Instead, all cutting treatments done on suitable lands would be limited by the allowable sale quantity (ASQ) volume.

Long-term Sustained Yield Capacity and Allowable Sale Quantity

Timber harvest levels must be based on the principle of sustained yield (Section 13 of the NFMA and Section 219.16 of the 1982 Planning Rule provisions). Long-term sustained yield capacity (LTSYC) is the uniform wood yield from lands being managed for timber production that may be sustained under a specified management intensity that is consistent with multiple-use objectives. LTSYC is computed based upon the premise that periodic harvest and regeneration is desired or necessary to meet land management desired conditions. Desired conditions are based upon multiple use objectives. Highest potential yield was not an objective in any alternative. The cutting methods and silvicultural management strategy used for the LTSYC calculations are consistent with the stated land management objectives.

Allowable sale quantity (ASQ) is the quantity of timber that is planned to be sold from the suitable timberland covered by the forest plan for a time period specified by the plan. ASQ is usually expressed on an annual basis as the "average annual allowable sale quantity" because it may be exceeded in a given year as long as the 10-year average is not exceeded. ASQ and LTSYC apply only to those lands that are suitable for timber production. That is, where there is the intent to have regular harvests for the purpose of producing commercial timber products, while managing for other resource objectives. ASQ can depart from (exceed) the projected LTSYC provided that such planned departure is consistent with and leads to the better attainment of multiple use management objectives.

For the purposes of this analysis, ASQ was calculated based on the Ponderosa Pine and Mixed Conifer with Frequent Fire ERUs. The Mixed Conifer with Infrequent Fire ERU was not included in the calculation of ASQ, as it represents only a minor component of the land suitable for timber production (slightly over 1 percent). The Ponderosa Pine and Mixed Conifer with Frequent Fire ERUs are highly departed in terms of density, structure, and susceptibility to unnaturally high-severity crown fire. To make progress toward desired conditions for these ERUs, timber harvest levels will have to be substantially greater than the estimated LTSYC until such time as desired conditions (e.g., reduced tree density, uneven-aged structure, and reduced crown fire risk) are attained. LTSYC is roughly equivalent to growth/production that can be sustained over time. However, LTSYC is only applicable once the desired density and structure have been achieved.

Special Forest Products

Although collection of forest products was an activity attributed to only 2.8 percent of forest visitors (USDA Forest Service 2016n), American Indian tribes are known to gather certain types of special forest products and forest botanical products for ceremonial and cultural purposes. Additionally, forest users (American Indian and non-American Indian) participate in firewood collecting, whether by a free-use or paid permitted activity. In 2015, there were 17,676 cords of firewood removed from the forest by paid permit, and 2,161 cords by free-use permit.

Environmental Consequences

All alternatives would have the effect of providing forest products to the economic and cultural benefit of surrounding communities and local American Indian Tribes. Each alternative contains plan direction that the forest would provide a sustainable supply of forest products with consideration to multiple-use objectives and consistent with desired conditions of other resources. However, alternatives B (modified), C, and D provide more specific direction for forest products. Desired conditions promote the availability and removal of forest products consistent with other resource desired conditions (FW-FProd-DC-1) and

silvicultural treatments reflect natural disturbance regimes and contribute to ecosystem sustainability (FW-FProd-DC-2).

All alternatives would provide forest products for personal and commercial uses at levels that are consistent with desired conditions, sustainable, and with consideration of other uses on the forest (table 60). Alternatives B (modified) and D would also provide forest products in higher amounts than alternatives A and C, and further contribute to the local economy, while helping to achieve vegetative desired conditions more rapidly than alternatives A and C. The difference in forest product levels between alternative A and that of alternative B (modified) is the byproduct or indirect effect of implementing plan objectives to move the forest toward vegetation and fire desired conditions.

Table 60. Estimated 5-year average of annual forest product removal and availability, by alternative

Forest Product	Current Actual Removal[1]	Alternative A	Alternative B (modified)	Alternative C	Alternative D
Harvest-Softwood Sawtimber (CCF)	25,056	152,247	170,510	151,964	170,510
Harvest-Softwood Pulp (CCF)	6,528	23,476	26,299	23,432	26,299
Harvest-Hardwood Sawtimber (CCF)	0	0	0	0	0
Harvest-Hardwood Pulp (CCF)	0	0	0	0	0
Poles (CCF)	24	24	24	24	24
Posts (CCF)	25	25	25	25	25
Fuelwood (CCF)	10,625	10,625	10,625	10,625	10,625
All Other Products (tons)	122	122	122	122	122

[1] Equals 5-year average

Suitable Timberlands, Long-term Sustained Yield, and Allowable Sale Quantity

In order to determine lands suitable for timber production, lands that are determined to be not appropriate for timber production are removed from the lands that have been identified as tentatively suitable for timber production. Areas not appropriate for timber production are specific to each alternative and are not those that are either not desirable or not feasible to manage for periodic harvests of forest products (see appendix G, table G-1). Lands not appropriate for timber production include: lands where management prescriptions preclude timber production, management requirements cannot be met, and where it would be not cost efficient in meeting timber objectives.

Each alternative used timber component codes (TimCo) to identify areas of land where management prescriptions preclude timber production. These codes are assigned to each stand in the vegetation database that identify areas of suitability or non-suitability for timber management and also identify areas of management for activities other than timber management. Additional information on TimCo can be found in Volume III, Appendix G. Lands not appropriate for timber production varied by alternative as displayed in table 61.

Table 61. Categories of lands not appropriate for timber production and the alternative-specific attributes that would result in lands not appropriate

Category of Lands	TimCo	TimCo Description	Areas by Alternative			
			A	B (modified)	C	D
Management Prescriptions Preclude Timber Production	800	Incompatible With Multiple Use - Critical Wildlife Habitat		Mexican spotted owl PACs		
	803	Incompatible With Multiple Use - Critical Wildlife Habitat - Old Growth	Allocated Developing and Existing Old Growth	NA	Allocated Developing and Existing Old Growth	NA
	810	Incompatible With Multiple Use - Experimental Forest, Range, or Watershed		Same for all Alternatives		
	301	Unsuitable Forest Land - Wilderness	NA	3 Rec. Wilderness Areas	13 Rec. Wilderness Areas	NA
	302	Unsuitable Forest Land - Research Natural Areas	NA	New Research Natural Areas		
Not Cost Efficient in Meeting Timber Objectives[1]	850	Cost Efficiency - Low Product Value		Same for all Alternatives		
	860	Cost Efficiency - Road Construction Problems		Same for all Alternatives		
	870	Cost Efficiency - Isolated Patch of Forest Land		Same for all Alternatives		
	880	Cost Efficiency - High Logging Cost		Same for all Alternatives		
Lands Where Management Requirements Cannot be Met	NA					

[1] See Financial Evaluation section in Volume III, Appendix G for additional details on cost efficiency.

All alternatives identified lands incompatible with multiple use – Experimental Forest, Range, watershed (TimCo 810), and lands incompatible with multiple use-Critical Wildlife Habitat, such as protected activity centers (PACs) for Mexican spotted owls (TimCo 800). Alternatives B (modified), C, and D included lands with the recommended research natural areas (TimCo 302). Alternative A does not include any recommended research natural areas. The effect of identifying these lands as not appropriate for timber production is that these areas would not be available for timber production. However, restoration activities could still be conducted in these areas.

Alternatives A and C included lands incompatible with multiple use-Critical Wildlife Habitat-Old Growth (TimCo 803). Alternatives A and C would retain the old-growth direction from the 1987 Plan, requiring at least 20 percent of the naturally forested area by forest type in any landscape be developed to retain old-growth function. Because these forested areas would be managed to retain a minimum of 20 18-inch trees

per acre with at least 90 square feet of basal area per acre and 50 percent canopy cover, they were removed from the suitable timber base (table 61 and table 62). Management for these conditions differs from the regionally consistent desired conditions in alternatives B (modified) and D, which strive to create uneven-aged structure and maintain old-growth attributes across the landscape, not just on 20 percent of the area.

Alternative B (modified) included lands within three recommended wilderness areas (TimCo 301). Alternative C included lands within 13 recommended wilderness areas (TimCo 301). Alternatives A and D do not recommend any additional wilderness areas.

In addition, areas of land were identified as not cost-efficient in meeting timber objectives due to the excessive costs (e.g., road construction) and low/negative returns associated with timber harvesting (e.g., preparation/logging costs) and removal (e.g., haul costs). These include small lands with low product value (TimCo 850), high road construction costs (TimCo 860), high logging costs (TimCo 880), and isolated patches of commercial timberland (TimCo 870). These were the same for all alternatives.

For example, road construction costs range from $15,000 to $25,000 per mile compared to re-construction costs for existing roads that range between $5,000 and $8,000 per mile. Once new roads are constructed, they must be either maintained at an average cost of $500 to $800 per mile each decade or be obliterated and seeded at an estimated cost of $2,000 per mile. In many of these areas, harvest volumes are low and harvest preparation and logging costs are excessively high. When ground-based mechanical (tractor) logging is not feasible and other harvesting systems (e.g., cable/helicopter) are required, logging costs generally increase by 200 to 300 percent (MSU 2006). In areas that would have very high operating costs, regular entry for purposes of timber production is not financially feasible.

For each alternative:

> **Lands Suitable for Timber Production** equals (=)
> Lands Tentatively Suitable for Timber Production minus (-)
> Tentatively Lands Not Appropriate for Timber Production

Acres of lands not appropriate for timber production were calculated for each category by alternative (table 62). Negative values indicate acres not appropriate for timber production that were removed from the lands tentatively suitable for timber production. The effects of the alternatives are reflected in the acres of the forest that are identified as suitable for timber production (table 62). Alternative D provides the most acres suitable for timber production and alternative A provides the least.

Table 62. Calculations for acres of lands not appropriate for timber production by alternative

Land Category	Acres by Alternative			
	A	B	C	D
Tentatively suitable for timber production	613,251	613,251	613,251	613,251
Management prescriptions preclude timber production	-138,274	-82,200	-139,533	-81,845
Not cost efficient in meeting timber objectives[1]	-8,877	-8,877	-8,877	-8,877
Management requirements cannot be met	0	0	0	0
Subtotal: Not appropriate for timber production	-147,151	-91,077	-148,410	-90,722
Suitable for timber production	**466,100**	**522,174**	**464,841**	**522,529**
Not suitable for timber production	**1,376,864**	**1,320,790**	**1,378,123**	**1,320,435**

[1] See Financial Evaluation section in Appendix G for additional details on cost efficiency

The ASQ and LTSY vary by alternative and are based solely on suitable timberlands. The ASQ for all alternatives is projected to be well above the LTSYC calculations for all alternatives for the next 5 decades. Based upon the objectives to treat 27,550 acres per year (26,050 Ponderosa Pine acres and 1,500 Mixed Conifer with Frequent Fire acres), much of the overstocked acres would be treated in the first two decades, which is partially why the ASQ exceeds the LTSYC by such a large margin (table 63). Existing forest conditions are dominated by single-storied (even-aged), closed canopy states consisting of primarily medium-sized (10- to 20-inch d.b.h.) trees. Because of existing overstocked forest conditions and high level of departure, it may take 80 to 100 years to reach desired conditions (Youtz and Vandendriesche 2012).

Table 63. Average annual allowable sale quantity and long-term sustained yield capacity, volumes (CCF) by alternative

	Alternative A	Alternative B (modified)	Alternative C	Alternative D
Allowable Sale Quantity	175,723 CCF	196,809 CCF	175,396 CCF	196,809 CCF
Long-term Sustained Yield Capacity	96,337 CCF	107,929 CCF	96,085 CCF	107,994 CCF

[1] CCF = one hundred cubic feet

Table 64 outlines the expected maximum harvest volumes for the Coconino NF for the 10 years following plan approval. The total volume for pulp and sawtimber in each alternative equals the ASQ for the decade. For example, under alternative B (modified), the ASQ for the first decade is 1,968,091 CCF (hundred cubic feet).

Table 64. Expected maximum harvest levels per decade

Alternative	Vegetation Type	Acres	Pulp (ccf)	Sawtimber (ccf)	Total (ccf)
A	Ponderosa Pine Forest	212,630	223,885	1,443,853	1,667,738
	Mixed Conifer with Frequent Fire	12,910	10,875	78,617	89,492
	Totals	**225,540**	**234,760**	**1,522,470**	**1,757,230**
B (modified)	Ponderosa Pine Forest	238,560	251,177	1,619,866	1,871,043
	Mixed Conifer with Frequent Fire	14,010	11,811	85,238	97,049
	Totals	**252,570**	**262,988**	**1,705,104**	**1,968,091**
C	Ponderosa Pine Forest	212,220	223,454	1,441,100	1,664,554
	Mixed Conifer with Frequent Fire	12,900	10,862	78,542	89,404
	Totals	**225,120**	**234,316**	**1,519,642**	**1,753,958**
D	Ponderosa Pine Forest	238,560	251,177	1,619,866	1,871,043
	Mixed Conifer with Frequent Fire	14,010	11,811	85,238	97,049
	Totals	**252,570**	**262,988**	**1,705,104**	**1,968,091**

As this analysis reflects, LTSY and ASQ are based solely on suitable timberlands. More acres of land suitable for timber production has the effect of creating more acres being managed for LTSY of wood products and more opportunities for timber production. Increased timber production would result in additional jobs and income related to management of the Coconino NF. While lands identified as suitable for timber production would be managed for LTSY of wood products, they would still be required to maintain or move toward the desired conditions for the resources within them.

Restoration treatments on lands not suitable for timber production would also have the effect of producing additional jobs and income from those efforts and any wood products that are removed. Restoration efforts would also have the effect of moving the treated area toward the desired conditions for the natural resources within it. The volume of the wood products associated with restoration treatments on lands not suitable for timber production are not included in LTSY and ASQ because those calculations are based solely on timberlands that are suitable for timber production.

Special Forest Products

Common to All Alternatives

All alternatives have direction to make special forest products available (1987 Plan, pages 23, 117, 135, 137, 155, 169; FW-FProd-DC-1, FW-FProd-G-3). Applying this direction, all alternatives were estimated to have the effect of producing 24 CCF of poles, 25 CCF of posts, 10,625 CCF of fuelwood, and 122 tons of other forest products (table 60). These are the same as current levels of removal of special forest products, so none of the alternatives would impact the current levels of removal.

Alternative A

In addition to the general direction relating to special forest products, alternative A provides plan direction to make forest products such as boughs and herbaceous plant parts available to American Indian Tribes under conditions and procedures that minimize restrictions, consistent with laws, regulations, and agreements with Tribes (1987 Plan, page 52). However, this alternative acknowledges that for items such as removal of firewood or kiva logs, a permit would be required (1987 Plan, page 52). This direction would have the effect of reducing administrative barriers to access to some special forest products used by American Indian Tribes.

Alternative B (modified)

Alternative B (modified) also contains plan direction that addresses the traditional and ceremonial Tribal uses for forest products. Alternative B (modified) would go further and specifically include the availability of timber products for traditional purposes, such as kiva beams and firewood, in the list of products that are available under conditions and procedures that minimize restrictions and are consistent with laws, regulations, and agreements with Tribes (FW-FProd-DC-3). This alternative does not expressly state that a permit would be required for any of these special forest products. Additionally, a desired condition in alternative B (modified) states that traditional Tribal uses, such as collection of special forest products, would be facilitated (FW-FProd-DC-3). One of the management approaches in the Forest Products section reminds forest managers to "[R]ecognize the needs of members of tribes whose historic ties include the land now administered by the Coconino NF to collect forest materials for traditional, ceremonial, and subsistence purposes." Another management approach reminds forest managers to "[W]ork with tribal members to facilitate collection of forest products needed for traditional activities and ceremonial uses." These plan components and management approaches should have the effect of ensuring that these special forest products are made available for traditional and ceremonial tribal uses, and with fewer administrative barriers to American Indian Tribes.

In addition to this plan direction, alternative B (modified) recommends the addition of three wilderness areas (8,733 acres) and a combined botanical and geological area (763 acres). Motorized access would be limited within these areas, and collection of forest products would have to occur by non-motorized (and non-mechanized) means, with the exception of limited administrative access and permitted uses. These elements of the alternative may have an effect on the availability of forest products to the public, including American Indian Tribal members, in certain areas. However, these adjustments in availability would not impact the amount of forest products made available to the public because most of these permits are forestwide. Furthermore, additional restrictions on motorized uses may not appreciably affect

the availability of forest products in these areas as they currently have limited collection opportunities because of terrain and a lack of NFS roads within them.

Alternative C

Alternative C includes the same plan direction related to special forest products as alternative B (modified), including the plan direction for traditional and ceremonial tribal uses for forest products with the corresponding effects discussed above in the alternative B (modified) section.

The addition of 13 recommended wilderness areas (91,757 acres), a new combined botanical and geological area (763 acres), and 8 management areas that emphasize reduced human-related disturbance (335,371 acres) under alternative C would not impact the amount of forest products made available to the public because most of these permits are forestwide. Motorized access would be limited within these areas, and collection of forest products would have to occur by non-motorized means (and mechanized means would also be excluded in the botanical and geological area), with the exception of limited administrative access and permitted uses. These elements of the alternative may have an effect on the availability of forest products to the public, including American Indian Tribal members. Furthermore, additional restrictions on motorized uses may not appreciably affect the availability of forest products in these areas as many of them have limited collection opportunities because of terrain and a lack of NFS roads within them.

The only Christmas tree cutting area currently on the forest is within the Blue Ridge Management Area. There would be no difference in the management of this area under alternative C, because the only roads that are passable in the winter are those that would be open for public access in this management area. Therefore, the reduced motorized access under this alternative would not result in the area being closed to Christmas tree cutting or reduced access for this use.

Alternative D

Alternative D includes the same plan direction related to special forest products as alternative B (modified), including the plan direction for traditional and ceremonial tribal uses for forest products with the corresponding effects discussed above in the alternative B (modified) section.

Alternative D does not recommend any new wilderness and only recommends a new geological area totaling 185 acres. Accordingly, there would be a negligible difference between the effect of alternative D and alternative B (modified) because terrain and the lack of NFS roads within these areas already limit opportunities to gather forest products.

Cumulative Effects

The cumulative effects analysis timeframe for the forest products analysis is the next 10 to 15 years. Forest products are available on nearby Tribal lands and adjacent national forests to varying extents. The geographic setting for the cumulative effects analysis includes all lands within the forest boundary and lands the nearby tribal lands and adjacent national forests.

American Indian Tribes

The Hopi Tribe’s Hopi Woodland Management Plan includes objectives to implement sound silvicultural systems to benefit and improve forest growth and development, to allow tree cutting for ceremonial and cultural use, and to allow fuel wood harvesting for domestic use in designated harvest areas. Together, the management of forest products is enhanced by the cumulative management of the Hopi Tribe and the Coconino NF.

Forest Service

Future forest/woodland management strategies across all other national forests within the cumulative effects area are expected to be similar to those proposed for the Coconino NF. The Kaibab, Prescott, and Apache-Sitgreaves NFs have revised their land management plans. The Tonto NF is currently revising its forest plan. The Kaibab NF's revised plan identifies over 380,000 acres of land as suitable for timber production with an ASQ of nearly 108,000 CCF. The Prescott NF's revised plan identifies nearly 39,000 acres of land as suitable for timber production with an ASQ of over 40,000 CCF. The Apache-Sitgreaves NFs' revised plan identifies over 596,000 acres of land as suitable for timber production with an ASQ of approximately 122,000 CCF. Like the timber lands on the Coconino NF, these neighboring timber lands will generate jobs and income associated with their ASQs. These other national forests and the Coconino NF would use the very similar desired conditions for the forested and woodland ERUs, with uneven-aged silviculture and the return of fire and other natural disturbances to their natural roles. Accordingly, like the timber lands on the Coconino NF, while these lands identified as suitable for timber production on neighboring forests would be managed for LTSY of wood products, they would still be required to maintain or move toward the desired conditions for the resources within them. These combined efforts of generating forest products while maintaining or moving these areas toward desired conditions result in positive contributions to the social, economic, and ecological conditions across the cumulative effects area.

The Four-Forest Restoration Initiative (4FRI) is a planning effort designed to restore ponderosa pine forest resiliency and function across four national forests in Arizona including the Coconino, Kaibab, Apache-Sitgreaves, and Tonto NFs. The initiative area has been divided into multiple environmental analyses including at least two large analyses. The first large analysis has been completed and covers over 980,000 acres spanning both the Coconino and Kaibab NFs. Within this area, a suite of restoration treatments, including mechanical and fire treatments, have been analyzed on approximately 230,000 acres of the Kaibab NF and 355,000 acres of the Coconino NF. The second large analysis is currently under way and is expected to analyze treatments that would restore the resiliency and function of ponderosa pine forests that span the southern portion of the Coconino NF and portions of the Apache-Sitgreaves and the Tonto NFs. The restoration treatments occurring on three nearby national forests are expected to support and improve the positive outcomes of treatments on the Coconino NF by increasing the scale of restoration and reducing the vegetation and fire return interval departure across a larger landscape. With the Four-Forest Restoration Initiative aiming to achieve broad-scale restoration in Arizona, the contribution of additional commercial sawtimber and pulp by the Coconino NF would help support the local wood products industry and reduce the risk of uncharacteristic fire in ponderosa pine forests within and adjacent to the Coconino NF.

Overall, the availability of forest products and opportunities for collection would not be affected additively by other actions outside the forest, and cumulative effects are unlikely to result. Cumulative effects on forest product availability and collection opportunities may result if, for any reason, their availability declines on other lands in the local area or region. If this happens, public demand for forest products may exceed availability on the Coconino NF. This may result in conflicts among those who collect and use forest products.

Heritage Resources

Affected Environment

The natural resources on the Coconino NF have provided sustenance for people since the earliest appearance of humans in the New World. As such, the Coconino NF is located within a region that is known worldwide for its wealth of archaeological sites and significant cultural resources. Most of the sites of the prehistoric Northern Sinagua and Southern Sinagua cultures are on NFS land. Pre-agricultural traditions represented on the forest are the Clovis Paleo-Indians and the Early, Middle, and Late Archaic periods. Prehistoric agricultural groups, besides the Sinagua, include the Cohonina, Kayenta, Winslow, and Hohokam traditions. In historic times, the forest was used by the Hopi, Acoma, Zuni, Navajo, Hualapai, Havasupai, Paiute, Tonto Apache, and Northeastern Yavapai.

Since the start of the forest archaeological program in 1975, about 19 percent of the forest has been completely surveyed and about 40 percent has been sampled. Archaeological site densities are among the highest known site densities in the Southwest, ranging from 1 to 99 sites per square mile, but averaging about 12 sites per square mile. The National Register of Historic Places is the official Federal list of districts, sites, buildings, structures, and objects significant in American history, architecture, archaeology, engineering, and culture. National register properties have significance to the history of their community, State, or the Nation. Nominations for listing historic properties come from State Historic Preservation Officers, Federal Preservation Officers for properties owned or controlled by the United States Government, Tribal Historic Preservation Officers for properties on tribal lands (NPS 2011a) and individuals and organizations for properties on private land.

It is predicted that the forest contains about 75,000 archaeological sites, of which about 10,000 have been formally recorded. Of these, 2,503 have been determined eligible for the National Register of Historic Places, 481 have been determined ineligible for the Register, 63 sites or segments of linear sites (such as roads or logging railroad grades) have been determined to be contributing elements,[45] and 31 sites or segments of linear sites have been determined non-contributing elements. One hundred and forty-four sites are formally listed on the National Register of Historic Places either individually, as a district, or as part of a multiple property[46] nomination. Although formally determined not eligible for the National Register of Historic Places, nine fire lookout towers have been listed by the Forest Fire Lookout Association's National Historic Lookout Register.

Almost half of the sites recorded on the forest have been disturbed to various degrees by a variety of causes. Of the disturbances, 11 percent are due to natural causes, such as erosion, while 89 percent are due to human causes. Specific causes of damage vary considerably across the forest, but according to survey records, roads appear to be the greatest cause of damage throughout the forest, affecting about 20 percent of all recorded sites. However, it must be taken into consideration that many archaeological surveys have focused on roads or are in areas where roads occur.

Besides direct impacts to sites caused by roads, there is also an indirect impact from roads due to the access they provide to archaeological sites. Many studies of site vandalism in the Southwest find a direct correlation between looting of sites and their proximity to roads (Ahlstrom et al. 1992, page 23). During their regular activities, forest personnel routinely watch for evidence of site vandalism; however, the main

[45] A contributing element is a portion of an historic property or a feature associated with it, that adds to the historic significance of a property (NPS 2011b).
[46] A multiple property is a group of historic properties related by common theme, general geographical area, and period of time for the purpose of National Register documentation and listing (NPS 2011b).

source of site protection on the forest is conducted through the Arizona Site Steward Program, which is comanaged by the State Historic Preservation Office and the relevant land manager.

Approximately 150 places within the forest have been identified as "traditional cultural properties." A traditional cultural property is a place that is significant for its "role in a community's historically rooted beliefs, customs, and practices" (Parker and King 1990). On the forest, these consist of shrines, collecting areas, mountains, rock formations, cinder cones, parks, springs, waterways, trails, ancestral sites, and other places that have been identified as significant to the Hopi, Navajo, Yavapai, Hualapai, Havasupai, Apache, and/or San Juan Southern Paiute. A number of places, such as the San Francisco Peaks, are traditional cultural properties that are identified by several tribes as being sacred places or collecting areas.

Existing Federal law, regulation, and policy relating to heritage resources would apply regardless of alternative. As such, all site-specific project clearance surveys, procedures, and mitigation measures, if needed, would be addressed in the same way. Cultural resource surveys for proposed activities would be conducted prior to approving site-specific projects in compliance with Federal law and Forest Service policy. The Southwestern Region's programmatic agreement would be used when making site-specific decisions concerning compliance with the various laws and regulations pertaining to the National Historic Preservation Act, 36 CFR 800 Sections 106 and 110, and related legislation. This includes tribal consultation, undertakings subject and not subject to consultation, determining areas of potential effect, levels of inventory, determinations of national register eligibility, determinations of effect, and mitigation. Mitigation is determined at the project level and would most likely include avoidance of cultural resources by redesigning project boundaries, modifying implementation plans or excluding sites from treatments. When proposed activities would result in an adverse effect and avoidance cannot be accomplished, the adverse effect would be resolved in accordance with 36 CFR 800.

Nominating significant cultural resources for the National Register is required by law under all proposed alternatives. Sites determined eligible for the National Register have the same level of protection as sites nominated to or listed on the national register.

The curation of forest artifact collections is required by regulation, and the forest has an agreement with the Museum of Northern Arizona and a program with the Arizona Archaeological Society Certification Program to train avocational archaeologists on how to catalogue forest collections and prepare them for curation at the museum.

The General Crook Trail is a historic route from the early Euro-American settlers' wars with the Apache. It is marked by chevrons and blazed trees from Fort Whipple to Fort Apache, crossing the Apache-Sitgreaves, Coconino, and Prescott National Forests. The trail was used as a supply route by wagons supplying the forts. It also played a role as a tactical road by the cavalry during the Apache Indian Campaigns. A few old trees and rocks can still be seen with original blazes that mark the mileage from various forts. Many landmark names come from the mileage such as Thirteen Mile Rock and Twenty-nine Mile Lake. The General Crook Trail is currently designated as a national recreation trail but it is also a national historic study trail (see the Recreation section for more information).

Environmental Consequences

Common to All Alternatives

Effects to cultural resources can be both direct and indirect, as well as positive or negative. Most projects on the forest involve ground-disturbance, which usually destroys or severely damages any cultural resource that may be present. Direct negative impacts from large-scale projects such as powerlines, highways, timber sales, and juniper removal, range from total obliteration of a cultural resource during

bulldozer clearing of a right-of-way, or partial destruction such as pulling junipers growing in cultural resource sites or digging a drainage channel through a site. Indirect negative impacts can occur for example when drainage patterns are altered by construction work, by operation and maintenance activities along utility corridors and access roads, or when cattle wallows are formed around stock tanks and accelerated erosion or altered drainage from these activities impact a site. Vandalism and illegal digging in cultural resource sites may occur when access to areas is improved by new roads or utility right-of-way corridors.

Positive direct and indirect effects can result when archaeological surveys are conducted in advance of projects. The archaeological data base is augmented with the addition of new sites representing different site types, cultures, and time periods. Direct positive effects by some projects can improve the physical condition of cultural sites that are being damaged by natural or human-caused actions. For example, trees growing in sites can be cut down and removed by timber and fuelwood sales, dense vegetation can be controlled by prescribed burns, and erosion caused by run-off from roads can be stopped by constructing water bars during road improvement projects.

Specific effects caused by a project are variable and dependent on many factors: size and type of project, amount of surface disturbance, type of equipment used, whether it is a one-time project or a repeating event, and density of cultural resources. Other factors that influence the extent and magnitude of effects include whether the cultural resource is unique or commonplace, for example, is it a scatter of flaked stone, a 20-room pueblo, or a tribal initiation site; whether the cultural resource site has the potential to provide significant information about the past, or is it a common site type that has been extensively studied; whether the cultural resource dates to a time period that is seldom found, or a period that is well represented in the archaeological record. These and many other factors determine the effects that an activity may or may not have on a cultural resource and what protection or mitigation measures may be needed to avoid or mitigate those effects.

All alternatives follow national heritage resource policies and procedures and the First Amended Programmatic Agreement Regarding Historic Property Protection and Responsibilities Among New Mexico Historic Preservation Officer and Arizona State Historic Preservation Office and Oklahoma State Historic Preservation Officer and the Advisory Council on Historic Preservation and the United States Department of Agriculture (USDA Forest Service 2003b) (reviewed and concurred with by the Arizona State Historic Preservation Office, May 23, 2011) (R-3 PA). They would result in no negative impacts such as ground disturbance, soil compaction, or erosion to the resource, provided cultural resources are avoided by project activities or if projects are exempt from consultation because their effects would be minimal (see First Amended Programmatic Agreement Appendix A, Section II) (USDA Forest Service 2003b). Each alternative would preserve historic evidences within a 200-foot corridor along the General George Crook Military Road National Recreation Trail and proposed national historic trail (1987 Plan, pages 55 and 56, SA-NatlTrails-G-11). Activities within that corridor would not disturb any intact segments of the trail and would enhance the late 19th century appearance of the forest. Alternative A has direction to prepare a nomination for the road to the National Historic Trail System. This direction is a management approach in the section on National Trails under alternatives B (modified), C, and D. Finally, all alternatives would implement the Four-Forest Restoration Initiative, a landscape-scale restoration project that would avoid negative effects such as ground disturbance, soil compaction, or erosion to heritage resources, by following appendix J (“Standard Consultation Protocol for Large-scale Fuels Reduction, Vegetation Treatment, and Habitat Improvement Projects”) of the R-3 PA and existing policies and procedures.

Project Clearances

Alternative A
Alternative A repeats law, regulation, and policy (1987 Plan, page 52-53). Alternative A does not have objectives to conduct a comprehensive site class evaluation, and therefore, plan direction is lacking to prioritize the most vulnerable sites for protection.

Alternatives B (modified), C, and D
Alternatives B (modified), C, and D do not repeat law, regulation, and policy, but do establish an objective of making a comprehensive site class evaluation of the approximately 30 site types that are found on the forest. These evaluations would allow the forest to better evaluate site significance and, thus, better protect sites that contribute to the understanding of American history and prehistory. The stated objective is to evaluate at least 3 study units/site types every 10 years, with priority being placed on site types that are most susceptible to being damaged by fire, such as log cabins, petroglyphs, pictographs, and sites with wood or others containing perishable remains (FW-Hrtg-O-1).

By examining each site type as a class, and within specific localities, a better understanding of how sites functioned within their cultural and environmental settings would result. This would establish a context by which individual sites and areas could be better evaluated as to their significance for management purposes as well as for National Register criteria. Priorities could be established for protection, stabilization, and interpretation based upon their importance for understanding the prehistory and history of the forest.

Cultural resource sites that are significant would be more readily identified and would be better protected (than under alternative A) from project impacts that would physically damage cultural resource sites, especially during fire response, where the time to evaluate sites and effects to them needs to be completed very quickly. This is especially important because one of the major needs for change that drive ecological health is the need to restore fire-adapted ecosystems.

Site Protection

Alternative A
Alternative A does not address major needs for heritage management that have developed since the 1987 plan was approved. It does not mention collections management, or the need to have forest artifact collections properly catalogued and curated by a repository that meets current curation standards. As a result, artifacts recovered on the forest could be damaged or lost through improper handling and the knowledge and research potential would be reduced.

Negative project effects are those that cause physical damage to a cultural resource site or alter the natural setting in which it is located. Direct negative effects from projects such as powerlines, highways, timber sales, and juniper eradication, range from total obliteration of a cultural resource during bulldozer clearing of a right-of-way, partial destruction by pulling junipers growing in sites, or digging a drainage channel through a site. Indirect negative effects can occur when drainage patterns are altered by construction work, by operation and maintenance activities along utility corridors and access roads, when cattle wallows are formed around stock tanks, etc. Indirect negative effects may occur to cultural resource sites when access to areas is improved by new roads or utility right-of-way corridors. These include damage from off-road vehicles that drive through sites, particularly during wet ground conditions, or from vandalism and illegal digging in cultural resource sites.

Cultural resource sites are managed primarily to protect and retain their scientific values; that is, the specific information they have that may contribute important information to our knowledge of history or

prehistory. Protection means avoiding alteration of or damage to a site from activities or uses on the forest. Different types of sites have more or less significance depending upon what they can contribute to specific research topics. These research topics, or themes, are identified in the National Register of Historic Places in a series of bulletins that provide guidelines for evaluating the relevance of site characteristics to those themes. If a site is determined to have relevance to one or more themes, it is said to meet the criteria of eligibility to the National Register and until each site or site type category is evaluated, it must be protected and managed as if it is eligible until such time as it is formally evaluated as eligible or not eligible. When knowledge of significance is poor, all sites are protected more or less equally, which would result in too little management attention being paid to more significant sites. As a result, their settings and historic values would not be adequately protected or understood given limited Federal resources. The site management protocol of "locate, flag, and avoid" without any research to have a better understanding of what we have, how sites relate to one another, what makes them significant, why they should protected, and how to prioritize our limited resources would limit the forest's ability to better identify and protect their significant values, as well as provide for more substantial, well-reasoned nominations of sites and districts to the National Register of Historic Places.

From a visual quality or scenery standpoint, alternative A potentially could have the most impact to archaeological sites because it has the most acres classified as Modification or Maximum Modification visual quality objectives. These are the two categories in which most visual modifications (such as transmission lines and corridors) could occur. See section on Scenic Resources for more information. In addition, alternative A does not recommend new wilderness areas (in which new transmission lines would not be constructed). Alternative A dictates that new transmission corridors would avoid designated wilderness, research natural areas, geological and botanical areas, Elden Environmental Study Area and the ponderosa pine and mixed conifer vegetation types (1987 Plan, page 79). This would minimize the impact to archaeological sites but some of the highest densities of sites occur outside these two vegetation types. Landscape-scale special uses like transmission corridors usually cut straight paths across the landscape and when they are located through areas of high archaeological density, construction activities, as well as operation and maintenance activities, can damage or destroy numerous sites, compact soils, or cause erosion. The extent and magnitude of damage and impact to archaeological sites cannot be determined without knowing the exact locations of future energy related infrastructure. Even when projects are located to minimize negative effects to historic resources, it is rare for a large-scale project to not do recovery on some sites that cannot be avoided. Power lines also greatly alter the setting of the site and the roads used to access the line can be used by pothunters and other people seeking to collect artifacts illegally.

Alternative A identifies future geothermal site development, particularly on the north end of the forest, as a concern that could cause conflicts with other resources and uses, but it has no clear direction on how to consider these resources as part of leasing decisions. Instead, it promotes further USGS studies to determine whether a geothermal resource exists and promotes processing prospecting permits and lease applications. Any issued leases must comply with pertinent regulations and policy guidelines (1987 plan, pages 11 and 77). A list of important cultural sites was included in the current plan as needing withdrawal (1987 Plan, pages 81 and 82). Protection of national register sites from damage or destruction by mineral and energy developments was achieved by successfully removing specific National Register sites and districts from mineral entry; however, these withdrawals have since expired. In addition, while generally serving their purpose, several withdrawals were drawn incorrectly and excluded some of the major sites they were designed to protect from disturbance. In addition, alternative A does not provide criteria to identify or evaluate other significant sites and areas for protection that could be afforded them by mineral withdrawal, so sites not specified in the plan under alternative A would not be considered for mineral withdrawal, which puts them at greater risk for damage in areas with locatable mineral potential. While alternative A calls for protection of some significant sites, it does not have enough flexibility to protect

future sites from damage or destruction from construction, operation, and maintenance activities when mineral development cannot avoid impacts to them.

Unlike the other alternatives, alternative A does not recommend any new wildernesses, botanical, or geological areas. Alternative A recommends West Clear Creek RNA in a different location than the other alternatives, Rocky Gulch RNA, and an eastside and a westside extension to the RNA on the San Francisco Peaks. Management of research natural areas could indirectly protect cultural resources that co-occur with these special areas. Protections would include language that impose use restrictions as needed to keep areas in natural or unmodified condition, no off-road driving, no harvest of timber products or firewood, and provisions within allotment management plans to protect the uniqueness and ecological condition of the special areas (1987 Plan, pages 194 and 195). The West Clear Creek RNA and the two extensions occur within designated wilderness, which is an additional layer of protection for the cultural resources that occur within these areas. Alternative A does not explicitly limit dispersed recreation in most research natural areas, botanical areas, or geological areas but rather directs managers to assess carrying capacity where needed and limit visitors as needed (1987 Plan, page 195). Alternative A has more specific direction for the Oak Creek RNA and the Casner RNA because the visitor use is high. This direction includes limiting non-commercial group size to 25 in Casner RNA and to 12 persons in the West Fork of Oak Creek; prohibiting livestock grazing; prohibiting overnight camping and recreation fires in Casner RNA and restricting camping and prohibiting recreation fires in Oak Creek RNA; restricting recreation use as needed to keep these places in their natural, unmodified condition; prohibiting permitted commercial tours except in support of approved research; and withdrawing Casner Canyon RNA from locatable and leasable mineral entry (1987 Plan, pages 196-1 and 196-2). Limitations on visitors, commercial tours, and livestock would protect cultural resources where these uses are damaging existing sites or causing soil compaction, soil disturbance, or erosion within or adjacent to sites. By prohibiting overnight camping, there is no legitimate reason for people to be in cultural sites after dark, the time frame in which site looting often occurs. Another benefit to restriction of campfires is that the frequency of wildfires that could negatively impact the resource may be reduced.

Alternative B (modified)

Alternative B (modified) recommends three wildernesses, one botanical and geological area, and three research natural areas (Rocky Gulch, the east extension to the RNA on the San Francisco Peaks, and West Clear Creek RNA in a more inaccessible location than in alternative A). These designations are given to places of outstanding cultural, biological, geological, or scenic value and are managed with the intent of preserving and enhancing those values. To do this, special area designations have a number of management requirements that also contribute to the protection of cultural resources by minimizing developments, access improvements, and commercial uses. Most of these proposed special areas have very high archaeological or cultural significance. While specific restrictions may vary, depending upon the type of special area designation, restrictions may include prohibitions on logging, roads or motorized vehicle access, camping, large groups, and events and commercial tours unless they support the resources for which an area was established. These prohibitions address some common archaeological site threats (surface disturbance, vandalism, theft, soil compaction) because the minimization of surface-disturbing activities and the size of recreating groups results in minimizing the potential for vandalism, theft, and compaction of soil around sites uses (SA-RWild-G-1, 2, 3, 4, and 5; SA-RNABotGeo-G-1, 3, 4, 5, 6, 7, and 9). Table 65 shows the estimated number of sites (based on forest site density predictions) that could receive an additional level of protection above and beyond standard operating procedures by virtue of the recommended or proposed special area designations provided by each alternative.

Table 65. Estimated number of additional archaeological sites within recommended wilderness or proposed special area designation by alternative

Alternative	Estimated Number of Sites[1]
A[2]	0 sites
B (modified)	873 sites
C	4,372 sites
D	158 sites

[1] Estimates based on predicted site density class, 31 sites per square mile in very high density areas, 20 sites per square mile in high density areas. The estimates in this table used a value of 1 site per square mile for the San Francisco Peaks based on its high elevations, steep terrain, and past surveys.

[2] Alternative A does not recommend or propose additional special areas.

Alternative B (modified) further promotes cultural preservation by maintaining the shape, form, and condition of cinder cones outside the Cinder Hills Off-highway Vehicle Area and by recognizing the cultural importance of certain forest products (MA-VolcanWd-DC-1, 2 and G-1; FW-FProd-DC-3). Additionally, the provision to support long-term research and streamlining research permit procedures could encourage more institutional archaeological work to better understand the cultural resources of the forest (FW-.SpecUse-DC-6). Guidelines in special uses would further protect sites by recommending that commercial filming and photography at cultural sites be prohibited to prevent publicizing the location of cultural sites and that commercial tours at high interest archaeological sites should be consistent with site protection, visitor experience objectives, and tribal interests (FW-SpecUse-G-14 and 20).

Alternative B (modified) has a standard in Mineral Resources that would help protect archaeological resources and traditional cultural properties that may be eligible or have been determined to be eligible for the National Register of Historic Places by avoiding or mitigating impacts from mineral operations and activities (FW-Minerals-S-1). A guideline would protect cultural values by considering traditional cultural properties where historic preservation laws do not adequately protect the cultural resource in and of themselves for withdrawal for locatable minerals (FW-Minerals-G-1). This would protect cultural values if withdrawn. Another guideline would consider the prohibition of leasing, surface occupancy, or other leasing stipulations for leasable minerals in areas of very high archaeological site density that are potentially eligible for the National Register of Historic Places, traditional cultural properties where historic preservation laws alone do not adequately protect the cultural resource as well as in research natural areas, geological and botanical areas, wilderness, and the San Francisco Peaks/Mount Elden Recreation Area withdrawal (FW-Minerals-G-3). Some mineral activities are very difficult to design in a way that avoids impacting heritage sites by construction and operation activities, but others can avoid them more easily because they have a smaller footprint and do not take up large contiguous areas. Because of the large variability of impacts caused by ground-disturbing project, it is difficult to estimate how many sites would be affected without a sense of the scale, type, and technology of a proposed mineral project. Alternative B (modified) recommends adding another 6,579 acres to the Strawberry Crater Wilderness which would protect an estimated 320 sites from impacts by potential geothermal development that could result in impacts such as surface disturbance, vandalism, theft, and soil compaction.. Otherwise, this area would be available for geothermal leasing, and some of these sites could be impacted by the ground disturbance and a change in setting. This alternative recommends 1,739 acres in the Davey's recommended wilderness, which would protect an estimated 86 sites from impacts and 415 acres in the Abineau recommended wilderness, which would protect an estimated 3 sites from development associated with leasing.

Unlike alternative A, alternative B (modified) would have considerably fewer impacts to archaeological sites because it has the fewest acres (similar to alternative C) classified as Low to Very Low scenic integrity objectives. See section on Scenic Resources for more information. These scenery integrity

objectives are equivalent to Modification or Maximum Modification visual quality objectives used in alternative A. Low and Very Low are the two categories in which most visual modifications (such as transmission lines and corridors) could occur. Alternative B (modified) expands the direction in alternative A for environmental study areas and dictates that new transmission corridors should avoid all environmental study areas (FW-FlagN-G-2, FW-MtElden-G-6), which would protect any cultural resources that occur in these areas from ground-disturbing activities.

Plan components discourage the construction of new transmission lines, corridors, energy, communication, or other infrastructure in recommended wildernesses (8,733 acres in this alternative), research natural areas, and geological and botanical areas. This would protect any cultural sites that overlap these areas. See SA-RWild-DC-1, 2, 4, 5, and G-1; SA-RNABotGeo-DC-1, 5, and G-5.

Unlike alternative A, alternative B (modified) does not specifically discourage or prohibit energy or communication infrastructure in ponderosa pine and mixed conifer vegetation; however, the extent and magnitude of potential damage and impact to archaeological sites from construction and maintenance activities cannot be determined without site-specific knowledge such as location, technology, and type of structures.

Alternative B (modified) would prioritize sites for protection of site integrity and stability where the values are rare or unique and where sites have imminent risks or threats. This alternative would also maintain site significance, integrity and site eligibility especially for priority heritage assets (FW-Hrtg-DC-2 and 3). These desired conditions would provide more flexibility than alternative A to prioritize high-value sites when new funding or opportunities arise for site interpretation and preservation. Alternative A relies on a static list where priorities could change due to changes in site condition, such as a forest fire destroying a priority log cabin for stabilization but lacks flexibility. Alternative B (modified) allows better management and protection of sites from damage by project activities, commensurate with site significance.

Alterative C

Alternative C has the same effects as alternative B (modified) except alternative C would recommend more wilderness. Altogether, 13 recommended wilderness areas, expansion of one research natural area, two new research natural areas, one new geological special area, and one new botanical special area proposed in alternative C would provide improved protection for about 293 known sites, and 4,392 predicted sites by minimizing potentially damaging human activities, vehicle use, and operation of mechanized equipment in those areas. Recommended wilderness would restrict the construction of power lines through the south end of the Verde Valley, an area of very high archaeological site density, and would protect as many as 3,828 sites from disturbance, from changes in setting, and from increased vehicle access (which can increase the potential for looting) resulting from transmission line construction and maintenance.

Alternative D

Alternative D would have the same effects as alternative B (modified) except for the following. Unlike alternatives B (modified) and C, alternative D does not recommend any wilderness areas and so is similar to alternative A in this regard. It recommends the Cottonwood Basin Geological Area rather than the geological and botanical area in alternatives B (modified) and C. This would have the same effect as alternative B (modified), but with fewer acres it would confer some additional protections from soil-disturbing, and thus, cultural site-disturbing activities on potentially six cultural sites.

From a scenic integrity perspective and compared to alternative A, alternative D would have considerably fewer impacts to archaeological sites because it has fewer acres classified as Low to Very Low scenic integrity objectives. See section on Scenic Resources for more information. These scenery integrity

objectives are equivalent to Modification or Maximum Modification visual quality objectives used in alternative A. Low and Very Low are the two categories in which most visual modifications (such as transmission lines and corridors) could occur. It has about 2,500 more acres classified as Low scenic integrity acres than alternatives B (modified) and C.

Enhancement and Interpretation

Alternative A

Alternative A has no provision to analyze, summarize, and evaluate the results of hundreds of archaeological surveys and thousands of sites that have been recorded by the forest's archaeological program. Without such a provision, sites would continue to be identified, documented, and generally avoided by project activities. The number of sites amassed would continue to grow, but knowledge and understanding of those sites and their relative significance for understanding the human experience they represent would not keep pace.

Alternative A requires commercial tour guides coming to archaeological sites in the Sedona area to have Forest Service-approved training regarding site etiquette, prehistoric culture history, the mission of the Forest Service, and the interpretation of the sites to which they are permitted to take tour groups (1987 Plan, pages 206-27, 206-45). It also requires commercial tour guides in the Flagstaff area to coordinate their tours with the nearby national monuments to ensure archaeological interpretation and information about agency missions are comparable (1987 Plan, pages 206-65, 206-88, 206-92, and 206-110). Visitors to the rest of the forest, however, would not necessarily receive the same level of information and education about cultural resources and the need for their protection. Better informed visitors would be more likely to report vandalism or theft at sites and less likely to commit these violations. In addition, better informed visitors would be less likely to cause unintentional damage, because they would be more aware of site etiquette and the value of the resources they are visiting.

Alternative A does not address the Route 66 Historic All-American Road or the need for interpretive facilities that support its unique heritage needs and has no mechanism to identify and consider new sites for interpretive development. There is no guidance to support consistent management and interpretation of Route 66 where it crosses the forest. As a result, the forest's economic contribution to the byway would not be fully realized.

Alternatives B (modified), C, and D

Alternative B (modified) recognizes the niche the Coconino NF has for historic sites and trails as a dispersed recreational resource. It proposes an objective to increase the development of trails to respond to public demands (FW-Rec-Trails-O-1). While such development could put more sites at risk from ground-disturbing activities such as trail construction and maintenance or by providing vehicular access to sites and high-density archaeological site areas, monitoring and other mitigating measures will be put into place to avoid or minimize site disturbance.

Alternatives B (modified), C, and D call for interpretive facilities at trailheads and protection of historic trail or road segments that might be suitable for interpretation (FW-InterpEd-DC-2. These alternatives also recognize the need for interpretation of the Historic Route 66 All-American Road, several segments of which occur on the forest but are not identified or interpreted. Should interpretive development be considered, these three alternatives are the same in that they would follow the Arizona Department of Transportation's comprehensive plan for historic Route 66 (ADOT 2009). Interpretive development of Route 66 would result in additional cooperative opportunities through the Route 66 Scenic Byways Association and the Kaibab NF that already interprets several segments of the old road. It also would increase the economic contribution of the forest to tourism along the byway. See SA-ScenicRds-DC-1 and 2 and G-2.

Alternative A's site-specific guidance regarding commercial tour guides to or in archaeological sites has been broadened to apply across the entire forest, rather than just the Sedona and Flagstaff areas, in alternatives B (modified), C, and D. Providing commercial guides with site etiquette and archaeological site interpretation would help build partnerships with the private sector and provides the public with additional information about site protection and the importance of archaeological sites on the national forest. Better site stewardship and public education about heritage resources would lead to better protection of sites from vandalism, theft, and accidental damage by visitors. See FWFW-InterpEd-G-1, 2, 8.

Research and Curation of Collections

Alternative A
Alternative A does not mention collections management, or the need to have forest artifact collections properly catalogued and curated by a repository that meets current curation standards. As a result, artifacts recovered on the forest could be damaged or lost through improper handling and the knowledge and research potential would be reduced.

Alternatives B (modified), C, and D
Alternatives B (modified), C, and D include direction for the evaluation of site types that would contribute to the understanding of heritage resources in northern Arizona. These alternatives include a desired condition to specifically address the appropriate management of collections for research purposes (FW-Hrtg-DC-6).

Cumulative Effects

The cumulative effects analysis timeframe for the heritage resources analysis is the next 10 to 15 years. Continued growth, with associated changes in the cultural, social, and economic base of the area, is predicted for the near future of Coconino and Yavapai Counties. As these local populations increase, additional pressure for space, water, power, and additional infrastructure would result in additional pressures on the forest as well. This would impact the borders, integrity, and biodiversity of Federal lands surrounding such growing communities as more homes are built adjacent to NFS lands and a higher concentration of visitors travel to favored forest destinations, including visits to archaeological sites.

Increasing archaeological knowledge and information on the forest would result in more accurate and better archaeological interpretation not only for the Forest Service, but also for other agencies and individuals who interpret archaeological sites (such as museums, the National Park Service, Arizona State Parks, tour operators, guides, writers, and photographers). Opportunities for partnership with these groups can increase public awareness of site etiquette, the laws protecting archaeological sites, as well as the potential for mutual and coordinated interpretation across agency lines. All alternatives would serve to continue promoting the collective heritage resources of the region. Improving the public's understanding of these resources would result in improved enforcement of site protection measures and less vandalism and theft.

With the high density of archaeological sites in Arizona and the fact that 82 percent of land in the state is managed by governmental agencies (Arizona State Parks 2007, page 34), it is not surprising that there is considerable interfacing in the management of cultural resources. Prehistoric societies did not operate in a vacuum, nor do the landownership boundaries of the present relate to those of the past. Although agency missions differ, the National Park Service and Forest Service agree that interpretation of archaeological sites in both parks and forests must be done within a regional context and as parts of larger cultural systems (NPS 2007, pages 98–99).

Six national monuments are within or adjacent to the forest. The Walnut Canyon, Wupatki, Montezuma Castle, Montezuma Well, and Tuzigoot National Monuments are mandated to interpret the prehistoric Sinagua culture. Since most Sinagua sites are located on NFS land, there is active cooperation between the National Park Service and Forest Service in their interpretive and site-monitoring activities. This allows for a more cohesive approach to protecting sites and maintaining their research and historic values. The Sunset Crater Volcano National Monument was established to protect geologic formations of scientific and public interest. The plans for Walnut Canyon National Monument to construct a new visitor center may lead to new opportunities to interpret the archaeological history of the forest and display artifacts from the forest's collections, as is presently being done at both Tuzigoot and Wupatki National Monuments.

Information realized from archaeological surveys on NFS land has been very important to the National Park Service as they designed new exhibits and interpretations for national monuments in the Flagstaff and Verde Valley areas. Similarly, these same monuments have conducted intensive surveys of their land, which has been very useful to the forest for better predicting and understanding site distributions on the forest. Some National Park Service surveys have also been conducted on NFS land which would be useful for future project planning. These improvements in knowledge of site significance and distribution continue to make predicting unsurveyed locations that would have significant sites easier. In turn, it would increase efficiency of project planning and help increase the pace at which the forest can move toward desired conditions for other resources, particularly ecological restoration and fire management on a landscape scale.

The Sinagua Circle is planned as a self-guided tour to a number of archaeological sites in the eastern side of the Red Rock Ranger District. It would interpret settlement patterns, land use practices, and water conservation systems used by the Southern Sinagua during the A.D. 1300–1400 period, contemporaneous with the neighboring Montezuma Castle, Montezuma Well, and Tuzigoot National Monuments. In doing so, it will explain the interactions between these late sites as interconnected communities, rather than isolated ruins. This is an interpretive concept designed to promote interagency cooperation in interpreting the cultural resources of the Verde Valley, to provide heritage tourism dollars into the Camp Verde area and contribute to the Department of Agriculture's rural tourism development program. A recent study of recreational opportunities for the town of Camp Verde identified prehistoric and historic cultural resources as the best "brand" by which the town can increase recreational income. The Camp Verde government, local businesses, Fort Verde State Park, as well as Tuzigoot, Montezuma Castle, and Montezuma Well National Monuments have all enthusiastically agreed to participate in the project whenever it moves forward from the Forest Service. The potential for the Sinagua Circle to enhance interpretation at all three national monuments as a self-guided tour with associated resource materials is discussed in the Montezuma Castle-Tuzigoot National Monuments General Management Plan (NPS 2008, pages 32, 139, 192, 213, 235) as a major benefit to increase interpretive diversity in telling the Sinagua story to the public as part of our National Historic Protection Act Section 110 responsibilities. The recommended wilderness in alternative C would improve site protection in the area interpreted by the Sinagua Circle concept. Also, the greater focus on interpretation outside of the Sedona and Flagstaff area in all alternatives would help move the forest toward accomplishing the mutual goals of protecting and improving knowledge of these sites.

The forest is working with the city of Flagstaff's Heritage Preservation Program to develop a site-density prediction model they can use to assist in future development planning. They are considering the adoption of the model developed by the forest that is based upon environmental variables as reflected in the terrestrial ecosystem soils classification system (Miller et al. 1995). Using a model similar to the forest's should help improve planning for both agencies for managing programs and activities in the interface between forest and city lands.

Collectively, the archaeological activities of the forest, the National Park Service, Arizona State Parks, city of Flagstaff, museums, universities, business concerns, public and private groups, interpretive, protection, and recreational opportunities are being enhanced for all parties involved. Greater archaeological knowledge of the region is being assembled and used for many scientific, business, and land management purposes.

The continuing involvement of the Coconino NF archaeology program in promoting and encouraging archaeological interest in the area would continue to enrich our knowledge of the past, human society, and population responses to climate change. The plan in alternatives B (modified), C, and D to begin evaluating archaeological site types by archaeological localities would directly benefit the forest's ability to continue attracting institutions to the forest to investigate its prehistoric past for the knowledge, enrichment, and edification of the American public.

Tribal Relations

Affected Environment

The Coconino NF has been working and consulting with tribes in northern Arizona for many years before it became a requirement under law, policy, and executive order. The lands that presently constitute the forest have many sites, areas, and features that are considered to be ancestral or of traditional and ceremonial importance to a number of southwestern tribes. The forest archaeologist and tribal relations specialist have worked closely with these tribes to identify their traditional cultural properties, which occur throughout the entire forest, and have taken care to ensure they have not been impacted by project activities, other than those associated with the Arizona Snowbowl. The San Francisco Peaks, one of the most revered traditional cultural properties in the Southwest, is the location of the Arizona Snowbowl, and has been the subject of consultation with the Hopi Tribe since the 1970s.

The forest routinely consults with 13 tribes, (the Pueblo of Acoma, Fort McDowell Yavapai Nation, Hualapai Tribe, Havasupai Tribe, Hopi Tribe, Navajo Nation, San Carlos Apache Tribe, San Juan Southern Paiute Tribe, Tonto Apache Tribe, White Mountain Apache Tribe, Yavapai-Apache Nation, Yavapai-Prescott Indian Tribe, and Pueblo of Zuni), 7 Navajo Chapters (Cameron, Coalmine Canyon, Dilcon, Gap-Bodaway, Leupp, Tolani Lake, and Tuba City Chapters), and the Dine' Medicine Man's Association.

To date, tribal concerns have involved access to areas to perform ceremonies and collect plants, firewood, and other forest products for traditional cultural purposes. Tribes have appreciated the "shared stewardship" philosophy the forest used in the past for project consultations and management activities. Tribes support the forest's efforts at site protection and for active prosecution of Archaeological Resources Protection Act cases.

Tribes, however, have also voiced the desire for more transparency in knowing how their input is used in the forest's decisionmaking process and want greater involvement of forest staff and line officers in face-to-face consultations. Some complaints have been made about inconsistent approaches and procedures between different national forest units and that too often forest personnel leave before tribes know who to contact if they have needs or concerns.

Tribal relations have deteriorated since the 2005 "Record of Decision for the Arizona Snowbowl Facilities Improvement," which approved the use of reclaimed water at the ski area that lies within the San Francisco Peaks Traditional Cultural Properties. Since then, numerous statements have been made by tribes that the forest holds no credibility with the tribes, and tribes lack faith in the forest's stated desire to

support tribal needs and values. Many tribes feel their trust in the forest has been broken because of the Snowbowl decision.

Environmental Consequences

Common to All Alternatives

The Coconino NF is bound by several legal obligations to maintain relations with tribes and managed resources of tribal importance; these include: the Archaeological Resource Protection Act (ARPA), the American Indian Religious Freedom Act (AIRFA), the Native American Graves Protection and Repatriation Act (NAGPRA), Executive Order (EO 13007), EO 13287, and the National Historic Preservation Act (NHPA) Sec. 106. The importance of tribal relations, sensitivity to tribal needs, and providing forest products are prominent in alternative A (1987 Plan, (pages 1, 14, 52-3, 52-4, 101, 108, 163, 206-16, 206-17, and 206-43)) and have been carried over into alternatives B (modified), C, and D (FW-Tribl-DC-1 to 4, FW-Trbl-G-1 and 2). Consequently, all alternatives would have the same effects on tribal relations: the process of respectful consultation regarding forest projects and activities of potential interest to tribes would continue and historic and prehistoric sites would be managed so as to prevent or minimize adverse impacts caused by forest activities, including high visitation to those sites.

The 2011 Coconino NF Travel Management Decision (USDA Forest Service 2011g) generally prohibits motorized cross-country travel. Under all alternatives, motorized cross-country travel is permitted under certain circumstances. The implementation of this decision, however, would not reduce tribal access to sites, plant materials, or forest products that are used in tribal cultural practices. Vehicular access to the forest for collecting materials, visiting sacred sites, and participating in traditional activities would be unchanged from the existing conditions under all alternatives. Tribal members would still travel on administrative use roads and cross country by permit to gather these materials using a variety of legal mechanisms including memoranda of understanding and special-use permits.

A policy developed jointly with the Coconino and Kaibab NFs clarifies and provides authority under which tribes may collect forest products under a free-use permit (USDA Forest Service 2012a). This should eliminate confusion and misunderstandings between native practitioners and Forest Service personnel about who, what, and under what conditions forest products can be collected for traditional and ceremonial purposes. This policy would continue under all alternatives and would promote the forest's desired conditions for tribal relations by providing a consistent approach between forests when dealing with the tribes, providing improved accessibility for traditional practices, and the potential for developing creative management opportunities between tribes and the forest.

Alternative A

Efforts to improve tribal relations would continue to be an important focus under this alternative, and the forest would continue to follow the existing and ongoing guidance provided by Regional and Washington Office directives. Efforts would be made to rebuild relationships damaged by the Arizona Snowbowl development decision. Tribal input on individual projects and on general cultural concerns would inform projects and improve the protection of the settings and sites that support the traditional cultural practices of American Indians. Alternative A does not specifically outline the overall goals for tribal consultation, so the process would continue much as it has in the past with an annual meeting about upcoming projects.

Alternative A includes plan direction on survey intensity associated with the Save the Jemez lawsuit (1987 Plan, pp. 52, 52-1, and 53). This direction is also addressed in the First Amended Programmatic Agreement Regarding Historic Property Protection and Responsibilities Among New Mexico Historic Preservation Officer and Arizona State Historic Preservation Officer and Texas State Historic Preservation Officer and Oklahoma State Historic Preservation Officer and the Advisory Council on Historic

Preservation and the United States Department of Agriculture-Forest Service Region 3 (USDA Forest Service 2003b).

Alternative B (modified)
Alternative B (modified) identifies new areas on the forest to recommend for wilderness designation. Through tribal consultation, no concerns were raised about any of the areas specifically, but some tribes were concerned that their access to materials and sites would be limited without motor vehicles, particularly for older tribal members. However, they also recognized the benefit of decreased access for other forest visitors in protecting cultural sites in areas recommended as wilderness. No site-specific area was identified where these concerns would manifest.

Tribal relations and consultation would continue to follow the existing and ongoing guidance provided by Regional and Washington Office directives. Developing tribally specific memoranda of understanding would be a priority. These memoranda of understanding would outline shared goals and processes. Under alternative B (modified), the forest would work to better define shared goals and outcomes for tribal consultation and would emphasize consistent process and interactions with neighboring national forests. As a result, the consultation process would be more meaningful for the tribes and forests, and would prevent confusion from separate consultation processes leading to different outcomes. Information shared by tribes with forests would be shared across other national forests, and joint meetings with multiple forests and tribes would be encouraged.

Plan language in alternative B (modified) explicitly states that collection of culturally important plants must be sustainable and not negatively impact the resource. Therefore, these alternatives have a greater potential to ensure that these plants will remain on the landscape. Alternative A only stated that the forest would allow plant gathering, but it does not take into account the long-term sustainability of the plant presence and distribution. Under alternative B (modified), the forest would work with tribes to protect these plant populations and prevent overuse. Language referring to the *Save the Jemez et al.* court case in alternative A is redundant with the 2003 programmatic agreement between the Southwestern Region of the Forest Service and the State Historic Preservation Offices. There would be no effect from removing the language in alternative B (modified).

Alternative C
The effects from alternative C would be the same as alternative B (modified).

Alternative D
The effects from alternative D would be the same as alternative B (modified), except there are no wilderness recommendations.

Cumulative Effects

The cumulative effects analysis timeframe for the tribal relations analysis is the next 10 to 15 years. Tribal relations in this country have been shaped by the history of interactions between the Federal Government and tribes. Today, each national forest conducts its own tribal consultation for proposed activities, so tribal consultation processes are somewhat insulated from actions by other jurisdictions. However, major controversies resulting from one process can affect the relationship between those tribes and other Federal entities. There are no identified actions by other entities that have affected the tribal relations with the Coconino NF. Occasionally, however, there are issues that affect tribal relations at regional or national levels. One of those examples, and arguably the largest strain on tribal relations between the Coconino NF and tribes it consults with has been the decision by the forest related to the Arizona Snowbowl, as mentioned earlier. Controversies associated with Red Hill on the Kaibab NF and Mount Taylor on the Cibola NF have further distanced Southwest tribes and reduced credibility toward the agency, in general.

There have also been ongoing national listening sessions and efforts to revise regulations concerning sacred site protection. The plan alternatives would not conflict with or duplicate any of these efforts. While plan alternatives would provide protection of sacred sites from other types of forest uses in a primarily strategic manner, they would not necessarily prohibit site-specific decisions that tribes could have objections to. All alternatives, however, would continue to follow existing and ongoing guidance provided by the agency and support the cultivation of positive relationships between the Coconino NF and tribes. The plan alternatives are not expected to have a cumulative adverse impact to tribal relations.

Infrastructure and Facilities

Affected Environment

Forest Road System

The Coconino National Forest Travel Management Decision (USDA Forest Service 2011g) changed the size of the NFS road system and categorized NFS roads as public roads or administrative use only. Public NFS roads are those open for the general public to use. Administrative roads are for Forest Service personnel, contractors, and permittees and, therefore, would likely have much less use and not be maintained as well as public system roads. Under the 2011 Travel Management Decision, the mileage of roads open to public motor vehicle use was reduced from 7,484 to 3,097 miles. This left 4,387 miles of road open for administrative use only or subject to obliteration. Annual motor vehicle use maps produced by the forest show which roads are open to public travel; all other roads would be used for administrative use only or are unauthorized and under consideration for obliteration. Private roads are roads that provide access to private property. Private roads are administered as easements or special use permits, and are considered in the Lands and Special Uses section. The motor vehicle use map would not be changed immediately following a decision on the forest plan, regardless of which alternative is selected, but rather, it will be changed according to the schedule established in the separate Travel Management process. Differences among alternatives are based on limitations and desired conditions in the alternatives that would guide future site-specific decisions about roads and access.

The forest road system within the planning area provides access to public lands and private inholdings. The majority of the access is provided for administration of the forest, public recreation, and forest product extraction. The motorized forest road system consists of 772 miles of roads open only to highway-legal vehicles (maintenance level 3-5), 3,157 miles of roads open to all motorized vehicles (maintenance level 2), 2,363 miles of roads available for limited administrative and permitted uses, and 544 miles of roads closed to all motorized vehicles (maintenance level 1). Many of these roads may be closed on a seasonal basis due to the structural stability of these roads being compromised during wet weather conditions. There are also additional seasonal closure areas that provide non-motorized hunting opportunities, such as the Woods, Pine Grove, and Rattlesnake areas and motorized vehicle closures to protect sensitive resources. The majority of National Forest System (NFS) roads above the Mogollon Rim are closed in the winter months for public safety and to maintain structural support of the roadway that may be weakened due to sustained moisture from snowfall. Roads may also be closed during extreme weather conditions for public safety and to minimize resource damage.

As part of the landscape-scale forest restoration effort known as the Four-Forest Restoration Initiative, the Forest Service is proposing to work with industry partners to accomplish a large, landscape-scale, multiyear forest restoration project in northern and central Arizona. The objective of the project is to treat 300,000 acres of ponderosa pine forest by thinning and harvesting mainly small-diameter trees over a 10-year contract period. Many of the areas proposed for treatment are within the Coconino NF. It is expected that new road construction may occur to access some of these areas. The majority of these roads

are expected to be temporarily used and then obliterated. In general, new road construction may also occur when access to a particular resource or private inholding is needed.

Administrative Facilities

The Coconino NF-owned administrative facilities within the planning area consist of 5 ranger stations, 2 work centers, 12 lookout facilities, 7 communication facilities, 4 guard stations, a Hotshot headquarters, and associated barns, warehouses, sheds, storage facilities, quarters for seasonal employees and crews, residential housing, and water and wastewater facilities. A review of administrative sites indicates there are currently 167 structures on the forest totaling 158,713 square feet (not including the leased supervisor's office located in the city of Flagstaff).

A revised facility master plan was completed in September 2003, and as of 2017, it is in the process of being updated. The facility master plan guides the acquisition, continued use, maintenance, improvements, and disposal of Forest Service facilities on the Coconino NF. The plan proposes an overall reduction in the number and square footage of administrative facilities through consolidation and decommissioning.

Environmental Consequences

Forest Road System

Changes to the forest road system were evaluated based on management guidance (e.g., desired conditions, guidelines, standards, objectives, and management approaches) and geographic delineations (e.g., recommended wilderness, management areas, primitive or semi-primitive non-motorized ROS settings) in each alternative that would influence future motorized access on the forest. Impacts from roads vary according to use, location, road maintenance level, and other factors.

This analysis looks at management designations and direction that would affect the forest road system and makes the assumption that across the forest, reduced miles of NFS roads would generally equate to decreased motorized access and ecological impacts from roads and increased opportunity for more primitive recreation. The ecological consequences of closing, decommissioning, and naturalizing roads generally result in increased wildlife habitat connectivity, reduced sedimentation and impacts to plants and archaeological sites, decreased vandalism and theft of archaeological sites, and less noise disturbance to wildlife. The exact magnitude and location of these effects, however, is difficult to assess at the plan scale because the effectiveness of achieving these effects is largely dependent on site-specific situation and design features. In general though, fewer roads equates to an overall trend of a decrease in these effects. It is also assumed that roads for administrative use only would have lower use and correspondingly fewer impacts to ecological resources than roads that are open to the public.

Common to All Alternatives

Throughout the Coconino NF, the Arizona Game and Fish Department offices of both Coconino and Yavapai Counties identified corridors of concentrated wildlife habitat critical to the migratory patterns of multiple species in a wildlife connectivity assessment. Many of these corridors are primarily on Forest Service land, but boundaries were delineated regardless of landownership. Among these critical corridors, NFS roads have not been deemed barriers to the prior-mentioned migratory patterns. Any mitigation of habitat fragmentation or modifications to NFS roads would be developed through a cooperative effort of Arizona Game and Fish Department and Forest Service on a site-specific basis and would apply under all alternatives.

Alternative A

Alternative A provides the greatest number of miles of NFS roads open to motorized travel, but it does not consider any new wilderness or management areas.

Alternative A would have no change on the affected environment by the current transportation system on the Coconino NF. The current levels of maintenance would stay the same and roads would be decommissioned or closed in compliance with the 1987 plan and the 2011 Travel Management Decision. The 1987 plan states that roads not needed for industry, public, and/or administrative use should be closed or returned to resource production by obliteration (1987 Plan, page 88). Under the management of the transportation system direction, these roads are to be obliterated at a rate of 40 miles per year (1987 Plan, page 12). It should be noted that the process of obliteration is encompassed by the definition of decommissioning. This would result in similar rates of obliteration in alternatives B (modified), C, and D as in alternative A.

Alternative A would provide the public with the most motorized access to the forest because there are no additional special areas, including recommended wilderness areas that would reduce motorized access. Alternative A has about 590,000 acres of forest within 1 mile of a NFS road. The 1987 plan provides direction to provide and manage a transportation system that fulfills the needs of the public (1987 Plan, page 24). By continuing to implement this guidance,, there could be potential ecological impacts due to sensitive species and areas being disrupted by human activity from motorized travel. There is no decision or plan direction to close or decommission roads or camping corridors. Likewise, there are no express suitability determinations included in this alternative. The road system and camping corridors would continue to be managed and adjusted through the Travel Management Rule process.

Alternative B (modified)

Alternative B (modified) provides a mix of road closures, new recommended wilderness areas, more areas managed for semi-primitive non-motorized ROS settings, and areas determined to be not suitable for temporary and permanent road construction, which would decrease the motorized travel on the forest compared to alternative A.

NFS roads and motorized access would be restricted due to changes in particular locations throughout the forest, and as a result, the road system would become smaller over time and the amount acres within one mile of an NFS road would increase. Alternative B (modified) contains approximately 204.6 total miles of roads that would possibly be closed to motorized travel by future site-specific decisions according to desired conditions and guidelines. (See FW-RdsFac-DC-1.) This would positively impact the surrounding vegetation, wildlife species, and watersheds that might otherwise be disturbed due to vehicle presence or the effects of an improperly located road. In addition, this would provide the public with more semiprimitive recreation opportunities without limiting forest motorized access unreasonably.

Alternative B (modified) could have fewer acres of forest within 1 mile of a road than alternative A due to future projects and other actions taken that could decommission road mileage. This alternative has desired conditions to provide wildlife with habitat connectivity that support viable populations for each species. (See FW-WFP-DC-1 and 6, FW-Water-DC-4, FW-Rip-All-DC-3, and FW-RdsFac-G-1.) Mitigation of habitat fragmentation for barriers, such as roads, would be considered on a site-specific basis throughout the life of the plan. Alternative B provides plan components that roads should minimize disturbance to wildlife (FW-RdsFac-G-1, FW-WFP-DC-1, FW-WFP-G-3, 8, and 11), minimize negative impacts on water/aquatic resources (FW-RdsFac-G-1, FW-WFP-DC-1, 2, 3, 4, 6, and 7, FW-Water-DC-1, FW-Rip-All-DC-1, 3, and 4), improve affected environment (FW-RdsFac-G-1, FW-Eco-DC-1, FW-Rip-All-DC-1, FW-TerrERU-All-DC-2), avoid or reduce the spread of invasive species (FW-Invas-G-1, FW-RdsFac-G-1, and FW-Invas-DC-1), and facilitate appropriate use of the roads.

Alternatives B (modified), C, and D

The objectives over the life of alternatives B (modified), C, and D are to decommission 200 to 800 miles of road. (See FW-RdsFac-O-1.) The roads to be decommissioned would be selected from those not identified on the motor vehicle use map (MVUM). Identifying which roads should be identified on the MVUM is determined through the Travel Management Rule process after public involvement in a separate environmental analysis. Roads may not have been identified on the MVUM for a variety of reasons, including closures resulting from changing ROS designations, desired conditions in management areas, watersheds, recommended wilderness areas and other special interest management areas. Decommissioning of roads would generally occur during the implementation of site-specific projects, such as 4FRI.

Alternative C

Among the alternatives, alternative C provides the greatest amount of recommended wilderness, which would decrease motorized travel on the forest compared to alternative A. Alternative C also alters the Anderson Mesa Management Area from alternative B (modified) and includes seven other management areas that emphasize reduced human-related disturbance. Compared to alternatives A and B (modified), the inclusion of these management areas would increase the amount of primitive and natural settings, decrease future opportunities for motorized access for both the public and administrative use, and provide the least number of miles of NFS roads open to motorized travel.

These management areas include guidelines that would limit public motorized access and decommission roads that are not needed for administrative use. However, these guidelines are designed to retain public access to developed sites, trailheads, and interpretive sites. Decisions on which roads would have limitations on public access would be based on future site-specific project-level analysis conducted under the NEPA process.

Under alternative C, there would be less disturbance from vehicle and human presence to the wildlife species and vegetation within the unique management areas and recommended wilderness areas than other alternatives. In addition, it would decrease motorized access to more remote recreational opportunities. Due to possible future site-specific decisions to close roads contained within management areas, alternative C could have fewer acres of forest that are within 1 mile of an NFS road.

Alternative D

The effects associated with alternative D would be similar to alternative B (modified), except that no new wilderness areas would be recommended. Accordingly, like alternative A, alternative D would provide the greatest number of miles of NFS roads open to motorized travel and retain future opportunities for both public and administrative motorized access on the NFS roads.

The effects of alternatives A, B (modified), C, and D associated with new recommended wilderness areas, recreation opportunity spectrum classifications, and transportation suitability are addressed in separate sections below.

Recreation Opportunity Spectrum

The recreation opportunity spectrum provides a framework that allows administrators to manage and users to enjoy a variety of recreation environments, including roaded access, and range from primitive to urban classifications (see the Recreation Affected Environment section for more information). Table 66 shows the breakdown of miles of road in the various ROS classifications by alternative. The classifications open to motorized travel range from semi-primitive motorized (SPM) to urban. Roads that are located in areas with primitive or semi-primitive non-motorized (SPNM) classification would likely be considered in the future for conversion to non-motorized trails or closed and naturalized to move the areas toward the desired ROS setting.

The road mileage that could be considered for removal from the NFS road system (public and administrative use) over time in areas with an ROS classification of primitive and semi-primitive nonmotorized ranges between 259 miles under alternative A and 366 miles under alternatives B (modified) and D. Such actions would decrease motorized access to these areas, but they would increase more primitive recreational experiences as well as habitat connectivity. Having larger contiguous areas with few roads would benefit wildlife that requires unfragmented habitat conditions to successfully migrate between resources during their life cycle. Likewise recreation users seeking a non-motorized experience would seek out these areas as road density decreases.

Table 66. Miles of public and administrative roads within recreation opportunity spectrum (ROS) classifications by alternative

Type of Use	Primitive	SPNM	SPM	RN	Rural	Urban	Non-Forest Service[1]
Alternative A[2]							
Public Use	20	36	1,129	2,424	78	0	4
Administrative Use	46	157	1,206	2,183	44	0	2
Alternative B							
Public Use	0.6	2	1,287	2,314	79	7	1
Administrative Use	21	342	1,468	1,756	44	8	0.4
Alternative C							
Public Use	12	2	1,276	2,315	79	7	1
Administrative Use	26	337	1,468	1,756	44	8	0.4
Alternative D							
Public Use	0.6	2	1,287	2,314	79	7	1
Administrative Use	21	342	1,468	1,756	44	8	0.4

[1] Alternatives B (modified) through D do not use "Non-Forest Service" as an ROS classification. The 457 miles of non-Forest Service managed roads, however, are included in the mileage totals within the ROS classifications use.

[2] Due to spatial accuracies and inconsistencies within GIS data, there were roads that crossed wilderness boundaries. These mileages were not included to represent actual road conditions within alternative A.

Recommended Wilderness and Other Special Areas

Only alternatives B (modified) and C have new recommended wilderness areas. Alternatives A and D do not introduce any new wilderness areas. Forestwide, alternative C recommended wilderness areas would encompass approximately 15.7 miles of public and administrative use roads within 9 new recommended wilderness areas; while alternative B (modified) would encompass approximately 0.6 mile of administrative roads between 2 new recommended wilderness areas.[47] It is assumed that these roads would be closed upon wilderness designation or earlier if these roads are impacting the wilderness character of areas recommended as wilderness. Such road closures would reduce both public and administrative motorized access to these portions of the forest. This is a particular benefit to heritage resources. Besides direct impacts to sites caused by roads, there is also an indirect impact from roads due to the access they provide to archaeological sites. Increasing wilderness and SPNM ROS classifications improves the protection for sites because, in many cases, it creates a greater distance between them and nearby roads.

[47] Some of the roads designated for public access in the Coconino National Forest Travel Management Decision were not in INFRA at the time of the potential wilderness Inventory. There were also some NFS roads that were not properly entered into INFRA that have been found through the work conducted to complete travel management. This is the reason for the public and administrative roads in the potential wilderness areas.

Among the alternatives, the miles of NFS roads within proposed and existing research natural areas, botanical and geological areas, and environmental study areas do not vary significantly between alternatives. Under alternatives A and D, there are approximately 57 miles of road in special interest management areas, which approximately 24 miles of road are open to the public. Under alternatives B (modified) and C, there are approximately 60 miles of road in special interest management areas, which approximately 26 miles of road are open to the public. New designations of these types would not preclude current motorized access under any alternative, but they would preclude new motorized access.

Motorized access in botanical and geological areas is not expressly excluded in the alternatives B (modified), C, and D; however, desired conditions and guidelines would protect and maintain unique characteristics of these areas and support the maintenance of inherent physical and biological processes (FW-RNABotGeo-DC-5). Processes would not be negatively impacted by human activities or permitted uses (FW-RNABotGeo-DC-5). A guideline to promote management of human activities, permitted uses, and types and levels of access in these areas to protect the uniqueness, ecological condition, and values of these areas (FW-RNABotGeo-G-1). Another guideline promotes predominantly foot traffic in this Botanical and Geological Area (FW-RNABotGeo-G-7). These plan components would positively impact the surrounding vegetation, wildlife species, and watersheds that might otherwise be disturbed due to vehicle presence, by decreasing the noise and ground disturbance that would affect these resources.

Transportation Suitability

Alternatives B (modified), C, and D include transportation suitability determinations. Suitability describes the appropriateness of applying certain resource management practices to a particular area of land. Identification of an area as suitable for a particular use does not mean that the use will occur over the entire area. Likewise, identifying that a particular use is not suitable in a management area does not mean that the use will not occur in specific areas. Identification of an area as suitable for various uses is guidance for project and activity decision-making and is not a resource commitment or final decision approving projects and activities. Final decisions on resource commitments are made at the project level. The transportation suitability determinations generally reflect the compatibility of different transportation systems or types with the desired conditions and objectives for various ROS classes, special areas, and environmental study areas. The potential effects from these transportation suitability determinations are the same as (not in addition to) the potential effects resulting from the various ROS classes, special areas, and environmental study areas in each alternative.

Table 67 summarizes the acres suitable for the future consideration of new motorized areas, NFS roads, and temporary roads. It is based on the acres within the Coconino NF for each management area under each alternative and the management areas suitable for these activities. It does not imply or propose these activities or level of development would occur, but it is a quantitative method to represent the differences among alternatives.

Table 67. Acres suitable for future consideration of new motorized areas, National Forest System roads, and temporary roads under alternatives B (modified), C, and D[1]

Category	Alternative B (modified)		Alternative C[2]		Alternative D[2]	
	Suitable	Not Suitable	Suitable	Not Suitable	Suitable	Not Suitable
New Motorized Areas	713,842	1,129,123	620,692	1,222,273	712,810	1,130,155
NFS Road Construction	1,465,920	377,045	1,109,467	733,498	1,469,290	373,675
Temporary Road Construction	1,665,046	177,919	1,585,113	257,852	1,681,450	161,515

Note: New roads or motorized trails are not suitable in wild and scenic river sections classified as wild. Also, a permanent road is only suitable in a wildlife habitat management area if administrative motorized travel is permitted or the road is exempted in the desired condition for the area. Where it is not permitted, permanent roads are not suitable.

[1] Alternative A is not included because transportation suitability is implied, but not quantified, in the 1987 plan.

[2] For more information, see transportation suitability tables for alternatives C and D in appendix F.

Alternative A

This alternative would have no change on the affected environment by the current transportation system on the Coconino NF. The current levels of maintenance would stay the same and roads would be decommissioned or closed in compliance with the 1987 plan. The 1987 plan states that roads not needed for industry, public, and/or administrative use should be closed or returned to resource production by obliteration. This alternative presents the public the most motorized access to the forest because there are no additional special areas that would reduce motorized access. Alternative A would have 1,635,186 acres of forest within 1 mile of an NFS road and outside of designated wilderness. The 1987 plan provides direction to provide and maintain a transportation system that fulfills the needs of the public. By continuing to implement this guidance, there could be potential ecological impacts caused by areas being disrupted by human activity from motorized travel. These impacts include fragmentation of habitat, noise disturbance to species, and sedimentation impacts to watersheds. In addition, this widespread access puts heritage sites at risk to vandalism and pot hunting.

Alternative B (modified)

Among the alternatives, alternative B (modified) provides a mix of road closures, new recommended wilderness areas, more SPNM settings and areas not suitable for temporary and permanent road construction. NFS roads and motorized access would be restricted due to changes in particular locations throughout the forest and as a result, the road system would become smaller over time. Alternative B (modified) contains 564.4 total miles of roads (82.5 miles that are currently open for public use) that would possibly be closed to motorized travel by future site-specific decisions according to desired conditions and guidelines (see table 92). This would positively impact the surrounding vegetation, wildlife species, and watersheds that might otherwise be disturbed due to vehicle presence by decreasing the noise and ground disturbance that would affect these resources. In addition, this would provide the public with more semiprimitive recreation opportunities without limiting forest motorized access unreasonably. Alternative B (modified) would have about 20,000 acres less of forest that are within 1 mile of a road and outside of designated wilderness than alternative A (see the “Recreation Suitability” section for more information). Alternative B (modified) has a desired condition to provide wildlife with habitat patches that support viable populations for each species (FW-WFP-DC-6). Mitigation of habitat fragmentation for barriers such as roads would be considered on a site-specific basis throughout the life of the plan. Alternative B provides guidelines that roads should be designed to minimize disturbance to wildlife, minimize negative impacts on water/aquatic resources, improve affected environment, avoid or reduce the spread of invasive species, and to facilitate appropriate use of the roads (FW-WFP-G-13 and FW-RdsFac-G-5 to 9). How each of these guidelines is implemented in road design and maintenance would be determined at the site-specific level.

Alternative C

Alternative C would likely result in the smallest road system because of multiple recommended wilderness areas, restrictions on public access in wildlife habitat management areas as well as other special management areas, and direction that would potentially close or obliterate routes in these areas. There may be up to 846.9 total miles of roads (111.1 miles are currently open for public use) that would be closed or decommissioned under alternative C. A smaller road system generally correlates with increased wildlife habitat connectivity, reduced sedimentation and impacts to plants and archaeological sites, decreased vandalism and theft of archaeological sites, and less noise disturbance to wildlife.

The wildlife habitat management areas included in alternative C encompass 69.8 miles of the 111.1 total miles of NFS roads currently open to the public that would be closed under this alternative. Table 68 shows the breakdown of potential road closure mileages by wildlife habitat management area; however, some mileages may be higher than those actually considered because of the nature of some roads and the type of access they provide. For example, roads that provide access to developed recreation sites, trailheads, or private land would remain open to maintain access to these areas. Roads contained within wildlife habitat management areas vary in ROS classifications from semi-primitive non-motorized to roaded natural. However, over the life of the plan, noncritical roads would be considered for closure or obliteration. All road obliterations or closures would be handled on a site-specific basis with NEPA analysis for each project.

Alternative C contains a guideline to reduce the public road density for the Anderson Mesa Wildlife Habitat Management Area to an average of 1 mile of road per square mile (FW-AMesa-G-3 in appendix F). Currently, the area has 1.01 miles of public roads per square mile; over the life of the plan, roads would be decommissioned and closed to lower the average to 1 mile per square mile. Road closures would result in a minimal reduction of roads within Anderson Mesa WHMA (approximately 4 miles). This guideline would also retain a public road density similar to current conditions, which would minimize the likelihood of increasing road density over time. Alternatives A, B (modified), and D, by contrast, could have higher road densities within this management area. Therefore, alternative C would have a net disturbance from human activities equal to or lower than other alternatives, assuming comparable levels of traffic. For wide-ranging wildlife species, such as pronghorn, this would maintain a stable amount of motor vehicle disturbance at this management area scale but may not result in stable disturbance to species whose habitat is at smaller scales. For example, a rare plant within this management area may currently have no road disturbance, but if roads are relocated without increasing the road density, the plant could be negatively impacted.

Alternative C would result in less vehicle and human disturbance to the wildlife species and vegetation within the various management areas and wilderness areas than other alternatives. In addition, it would decrease motorized access to more remote recreational opportunities. Alternative C would have about 77,000 fewer acres of forest that are within 1 mile of an NFS road and outside of designated and recommended wilderness areas than alternative A (see the Recreation Suitability section for more information).

Table 68. Potential public use road miles suitable for closures within wildlife habitat management areas (alternative C)[1]

WHMA	Public Use Road Miles
Anderson Mesa	Approximately 4.2
East Clear Creek	34.2
Hospital Ridge	1.1
Jack's Canyon	24.3
Knoll Lake	2.5
Limestone Pasture	1.4
Pine Grove	2.3
Second Chance	0
Total	**69.8**

[1] Table and closures are based on a combination between ROS and WHMA plan direction.

[2] This number is an estimate of the number of miles needed to meet the road density guideline for Anderson Mesa WHMA. Road locations would be determined at the project-specific level.

Numerous project analyses of sediment delivery from road surfaces indicate (through Water Erosion Prediction Project Monitoring (WEPP) road interface modeling) that decreasing traffic on native surface roads (i.e., maintenance level 2 and unauthorized roads) results in reduced sediment delivery into connected streamcourses within the associated watershed (USDA RMRS 2000, USDA Forest Service 1999,). Within East Clear Creek, Jack's Canyon, and Knoll Lake WHMAs, motor vehicle traffic would be limited to minimize impacts from motorized vehicle traffic to the wildlife emphasized within the WHMA and their associated habitats. Within these WHMAs, access would still be provided to developed sites, trailheads, and interpretive sites. Within Second Chance, Limestone Pasture, Pine Grove, and Hospital Ridge WHMAs, public motor vehicle access would not be provided. For all of the WHMAs, roads that are not open for public access would be managed for administrative use or decommissioned. Roads with administrative access would have low traffic, but would still be expected to have enough vehicle passes in a year or growing season to result in detachment of soil from the road surface. Subsequently, sediment would be transferred into connected stream courses following storm events. Administrative use only roads would still deliver less sediment than roads open to public motorized use. Therefore, roads open to the public would continue to have rates of sediment delivery similar to alternatives A, B (modified), and D and roads that have changed to administrative use only within management areas that emphasize reduced human-related disturbance would have lower rates than alternatives A, B (modified), and D.

Reducing road traffic would also reduce the frequency of road maintenance. If the restricted road is a maintenance level 3 road (which generally has culverts with an improved surface), parts of the road could fail and deliver appreciable sediment into stream courses in the watershed within 10 years of when motor vehicle restrictions become effective (table 69). For unauthorized roads and maintenance level 2 roads (which are already not maintained or maintained very infrequently and have native soil surfaces), discontinuing public traffic and road maintenance should not slow down natural vegetative recovery and soil stabilization on the roadway. Therefore, sediment delivery into connected streamcourses should be reduced over a 10-year period once motor vehicle restrictions become effective. The majority of roads that could have motorized restrictions in alternative C are maintenance level 2 roads. Therefore, reduced maintenance would not result in increased sediment delivery into streamcourses, and traffic reduction would lead to recovery of roadbed vegetation and soil stabilization, especially in the Upper Clear Creek watershed where the WHMAs are concentrated. However, where maintenance level 3 roads are changed to administrative use only, there would be limited maintenance once motor vehicle restrictions become effective and, as a result, culverts, drainage features, and road surfacing may fail.

Table 69. Comparison of effects to sediment delivery based on level of traffic and maintenance level

Type of Use	Amount of Traffic	Maintenance Level	Assumption	Effect	Sediment Delivery Effect
Administrative access	Lower	Maintenance level 2 and unauthorized roads	Infrequent to low maintenance currently	Some detachment of soil from road surface.	Low
		Maintenance level 3	Lower frequency of road maintenance than current	Culverts, drainage features, and road surfacing may fail.	Most: sediment delivered to stream courses within watershed within 10 years.
Open to public motorized use	Same as current use	Maintenance level 2 and unauthorized roads	Infrequent to low maintenance	More detachment of soil from road surface.	More
		Maintenance level 3	Highest frequency of road maintenance	Culverts, drainage features, and road surfacing are likely to function properly.	Less amount of sediment delivered to stream courses within the watershed since roads are maintained and S&W best management practices implemented.

Alternative D

Alternative D would be similar to alternative B (modified), except that no new wilderness areas would be recommended. In addition, mechanized recreation would be allowed on designated trails in botanical and geological areas. This alternative has the same amount of forest within 1 mile of an NFS road as alternative A, because there are no new wilderness areas recommended in this alternative. The ROS classifications (table 66) show alternative D contains equal mileage of roads open to motorized travel as alternative B (modified). Walker Mountain would still be unavailable to motorized travel because it is SPNM. In Davey's, there is likely to be more motorized travel access than alternative B (modified), because there is no recommended wilderness area proposed for alternative D. Similarly, in Strawberry Crater, the main activity that would continue is the occasional firewood gathering and low-intensity motorized recreation. It is uncertain whether these activities would increase over time. While an increase in motorized travel may affect the wildlife and vegetation in the areas by these roads through noise and ground disturbance as mentioned earlier, there would still be a low concentration of human activity

Administrative Facilities

Common to All Alternatives

Management of the administrative facilities on the Coconino NF would not change under any alternative. The facility master plan would be reviewed and updated every 10 years or as necessary due to changes in program staffing, as directed by FSM 1241, 2330, 7312.1 with guidance from FSH 7309.11 Sec 22.

Alternatives B (modified), C, and D

Alternatives B (modified), C, and D specifically provide guidance to balance management recommendations found within the facilities master plan (FW-RdsFac-G-10) and the desired conditions of the forest plan to determine how facilities would be managed over the life of the forest plan (FW-RdsFac-DC-7).

Cumulative Effects

The plan provides a programmatic framework that guides site-specific actions but does not authorize, fund, or carry out any project or activity. Because the plan does not authorize or mandate any site-specific projects or activities (including ground-disturbing actions), there can be no direct effects. However, there may be implications, or long-term environmental consequences, of managing the forests under this programmatic framework.

The cumulative effects timeframe for the infrastructure and facilities analysis is the next 10 to 15 years, and the spatial boundary includes the national forests adjacent to Coconino NF, State and county highways that access and traverse the national forest, cities encompassed by the national forest, easements to access inholdings, Coconino, Yavapai, and Gila Counties encompassing the national forest, and designated NFS highways on the Coconino NF.

Areas proposed for treatment as part of the Four-Forest Restoration Initiative are scattered across four national forests—Tonto, Kaibab, Coconino, and Apache-Sitgreaves. Use of NFS roads for access to treatment areas on the west side of the Sitgreaves NF, north side of the Tonto NF, and east side of the Kaibab NF would result in increased traffic and greater variety of vehicles to include heavy equipment. This would result in a need for more frequent road maintenance and possibly road improvements to accommodate this increased activity safely.

Completed, proposed, and planned road projects on and near the Coconino NF are included in the following regional road and transportation improvement plans:

- Arizona Department of Transportation State Transportation Improvement Program FY 2014–2018
- Arizona Department of Transportation Tentative 5-Year Transportation Facilities Construction Program 2015–2019
- Yavapai County Regional Road Program Planning Projects
- Flagstaff Area Regional Land Use and Transportation Plan
- Beaver Creek Regional Council Draft Beaver Creek Vision 2020
- Verde Valley Regional Land Use Plan Proposed Roadway Improvements

Road improvement and widening projects on and off the forest could have an impact on the forest. Projects on and near the forest could result in increased easements and could facilitate ease of access onto the forest. Projects outside the forest could decrease driving times to access the forest. In general, it is expected that these projects could result in more visitors to the forest and increased road maintenance needs. Increased visitation has variable effects depending on whether or not it occurs in an area with adequate capacity to provide recreation opportunities that are consistent with visitor expectations or not. On a forestwide scale, however, it is difficult to know the outcomes of increased visitation without site-specific information.

The Coconino NF road system could be impacted by the projects surrounding the forest; however, the effects would be minimal. The major effects of alternatives B (modified) through D on the road system stem from changing ROS classifications, proposed special areas, and management areas. These areas would be located in the more remote sections of the forest and would not be impacted by projects on primary travel arterials through the State. The increase in ease of access to the forest provided by some projects could increase traffic volumes on roads near major arterials that travel through the forest. This possible increase would not change the maintenance level of the roads, but it could possibly increase the maintenance needed to keep the road in proper condition because increased traffic increases

sedimentation and runoff on the road surface. Increased traffic can also increase dust for nearby homeowners and recreation visitors. Visitor expectations of road maintenance would also be expected to increase with traffic. Despite the possible increase in traffic volume, the sizes of the roads would not be altered due to the desired conditions stating that the need for public access must be balanced with the mitigation of ecological impacts.

Alternative A would not affect any State, county, or city transportation systems. Any alterations in the size of the NFS road system in alternative A would be provided in the guidelines of the 1987 plan. In addition, possible changes to the NFS road system brought about by alternatives B (modified), C, and D would not affect the overall municipal transportation system throughout the region. With few exceptions, such as NFS Highway 3 (Lake Mary Road) and other forest highways, forest roads are not used as primary travel routes between cities and towns. The loss of road mileage due to the changing ROS classifications, proposed special areas, and management areas would neither increase or decrease traffic volumes on primary arterials such as Interstate 17 or Interstate 40.

The NFS road system is a part of the overall transportation system throughout Arizona. NFS roads connect to collector roads as well as arterials throughout the state. The jurisdiction and maintenance responsibilities are divided among State, county, and Forest Service through the use of easements, permits, and cooperative maintenance agreements. For further information on this topic refer to the Land Use section.

Lands and Special Uses

Affected Environment

The lands program area includes land exchanges, purchases, boundary management, and other activities that are primarily real estate type activities. Special uses activities include authorizations to use NFS lands for non-Federal type uses. These uses can be things such as utility corridors, private and public roadways, churches, communications sites, or signs.

Landownership, Open Space, Land Exchanges, and Lands of Other Ownership

Adjustments

Applicable portions of the Coconino NF comprise about 12 percent of Coconino County and 8 percent of Yavapai County, respectively. The Coconino NF also occupies approximately 2 percent of Gila County. Several incorporated communities are located within the forest boundaries, including the city of Flagstaff, city of Sedona, town of Camp Verde, town of Clarkdale, and city of Cottonwood. Actions and plans of local communities and their growth and development influence Coconino NF through land adjustment cases, land exchange concerns, utility needs and development, and residential impacts. These communities are also partners in maintaining and acquiring open space and providing needed services to residents and users of the forest.

The night sky is also a major contribution to northern Arizona’s economy. Flagstaff has been designated the world’s first International Dark Sky City by the International Dark Sky Association. The natural surroundings of the Coconino NF contribute to the preservation of dark skies.

Approximately 39,900 acres of State of Arizona land lies within the proclaimed boundary of the Coconino NF that includes four state parks and mostly Arizona State Trust Lands. There are four national monuments within the Coconino NF boundaries—Montezuma Castle, Tuzigoot, Walnut Canyon, and Sunset Crater Volcano National Monument. All of these entities and their management plans influence adjacent national forests in some way, through uses or development influences. There has been an

increase in Coconino NF acreage of approximately 33,400 acres through a variety of land adjustment processes between 1987 and 2010. Community needs resulted in conveyance of lands for uses, such as schools, wastewater treatment facilities, fire stations, and landfills. Concerns about land exchanges and loss of NFS land have resulted in amendments that place restrictions for the Sedona and Walnut Canyon areas of the forest. Local communities have continued to express concerns about land exchanges, and land exchanges continue to be difficult and controversial projects even though important forest resources are acquired in these cases.

The Forest Service may acquire lands through exchange, purchase, donation, or condemnation. Land exchange and land purchase have been, and would continue to be, the means by which the Coconino NF acquires key wildland resources and open space areas. Most of the Federal lands exchanged are within or near existing communities and the majority of land conveyed to the forest is located in more remote areas. Generally, on a per acre basis, lands near existing communities and related infrastructure are valued higher than those acres in more remote acreages. Because of this difference in value, land exchanges on the Coconino NF from 1987 through 2006 resulted in a net acreage gain to the forest of 5,266 acres. Most of these exchanges involved multiple national forests in Arizona. The forest gained 8,528 acres and 3,262 acres went into private ownership. Through a variety of land adjustment processes, the Coconino NF has increased in net acreage by 34,400 acres between 1987 and 2010.

Only about 13 percent of the land in Coconino County is privately owned, limiting land available for development. Nine large ranch holdings account for approximately 71 percent of the private land, which has limited the available land base for development even further. Population growth has surpassed predictions written into the county plans. As a result, within Coconino County there is support for both private and public agency land exchanges and other types of landownership adjustments with the Forest Service, which result in additional private land to accommodate future development.

Some individuals and groups have opposed land exchanges, particularly in specific areas of the forest. The general public sentiment in the areas of Sedona and the Village of Oak Creek is opposition to land exchanges near these communities. Amendment 12 to the 1987 plan outlined restrictive land exchange direction Sedona and Village of Oak Creek areas. The Walnut Canyon Management Area near Flagstaff is another location where there has been opposition to land exchange. This restrictive sentiment was incorporated as a standard in amendment 17 to the 1987 plan. The opposition to exchange is specific to land disposal, as acquisition of lands in these respective areas by exchange or purchase remains acceptable. Recent trends on the Coconino NF, over the past 5 years, have included a significant increase in requests by other governmental entities to acquire NFS land by purchase under the authority of specific sale or grants such as the National Forest Townsite Act or the Education Land Grant Act. Another trend has been for land exchange proponents to lobby for and obtain special legislation for their exchange in an attempt to circumvent portions of the administrative process and/or to get their proposal priority through congressional mandate.

Procedures for processing cases and public participation is determined by set policies, rules, and regulations outside the forest plan and would apply regardless of the plan alternative selected.

Special Use Permits

Special-use authorizations on the Coconino NF continue to be an important and demanding program as a result of population growth. High population growth in the State of Arizona and all of the communities within the Coconino NF since 1987, have resulted in infrastructure demands, including widened and improved roadways and widened and new utility corridors and communications facilities. While research is not often considered to be a major use of Federal lands, the Coconino NF issues a number of special use permits for research purposes. Research on flora, fauna, water quality, seismic activity, weather, and

wildland fire effects is conducted by universities, private institutions, and other Federal, State, and local agencies.

Forests also commonly allow communities, industry, and other entities to use public lands for infrastructure, including power lines, rights-of-way, telecommunications, and the like. Special use permits for developments such as cell towers have increased over the past 20 years. With the changes in technology, the trend would be an increased need and demand for more of these types of developments and the services they provide. The increased demand for energy has generated increased emphasis on the management of utility corridors to provide additional service and to expand or create new corridors. Renewable energy resources such as wind and solar are resulting in new corridors being needed beyond the connections between existing traditional energy generator locations, and the forest has been increasingly involved in activities to accomplish this objective.

The city of Flagstaff and Verde Valley incorporated communities, and Coconino and Yavapai Counties are increasing in population, causing increasing water demand. Increased domestic water demand in Flagstaff would necessitate additional well drilling and procurement of additional water supply. Forest management of the municipal watershed in the Inner Basin and the Lake Mary watershed, a source of additional water for the city of Flagstaff, affects domestic water quality and supply. Requests for other water-related facilities, such as pipelines and water tanks, on Coconino NF continues as development and population increases occur.

The forest, as of 2007, has a total of 580 long-term permits, of which 194 are focused on recreation and the remaining 386 are non-recreation permits. All of these permits are issued for more than 1 year. These numbers do not include short-term or special product permits issued for 1 year or less, such as filming or group events. Annual or shorter term permits have ranged from 120 to 150 per year over the past few years. There were 453 active lands permits of record in June 2011, and approximately 40 in the process of being issued. Overall, the trend is an increasing demand for all permitted activities, especially those related to reliable and renewable energy resources and communications facilities.

Procedures for the review and response times for special use applications and requests are now set by policy and regulations outside the forest plan and would apply regardless of the plan alternative selected.

Environmental Consequences

Landownership, Boundary Management, Land Adjustment and Right-of-Way

Common to All Alternatives

Criteria for land adjustment cases are very similar among all alternatives and include a focus of acquisition of non-Federal land with key resource values such as archeological sites, threatened and endangered species habitat, high recreation value lands or access, special areas, and riparian/wetland habitat. Because the land adjustment criteria is similar among all alternative, potential land adjustments under the criteria would likely be similar for all alternatives. There would be a focus on acquisition and improved management of important forest resources, such as threatened and endangered species habitat, archeological resources, wetlands and riparian and key recreation access points. These resources could be removed or destroyed if private parcels are developed instead of acquired through land adjustment processes. Additionally, NFS lands with these types of resources would be retained in Federal ownership under all alternatives. Under the land adjustment criteria, key resources are acquired and retained to allow for forest management of these valued resources.

Public concern about being involved early in land exchange projects and continued support for community needs is addressed in all the alternatives. As a result, the public is informed of land exchanges

early enough to be able to meaningfully contribute to the outcome for the benefit of the community. This increases trust in the Forest Service's lands program and results in greater potential for successful implementation of land adjustment cases where valued lands are acquired.

Due to budgetary constraints, limitations of the plan direction and community influences and development, the forest would likely continue to increase in acreage, but probably at a slower rate throughout the life of the plan. As the complexity of land adjustment cases increase and budget and staffing is limited to complete these cases, non-Federal lands with important resources could be developed instead of acquired. Non-Federal inholdings within large areas of the national forest could be developed and result in improved access for forest uses but also increased recreation, new utility corridors, possible changes to forest users' recreation experience and contact frequency with others, and impacts to forest resources like wildlife habitat and scenery on NFS lands surrounding the development. There are also fewer acres of undeveloped non-Federal land within the forest and state with key resource values, so there are not as many opportunities to acquire additional land as in the previous planning period.

Amendment 12 and 17 standards concerning land exchanges in the Sedona and Walnut Canyon areas have been carried forward with updates for parcels that have already been conveyed. Specific direction for the Walnut Canyon area does not allow for conveyance of lands in this unit, including conveyances for government or public needs. The standard indicates that all NFS lands will remain under Forest Service jurisdiction. This direction would imply that an interagency transfer to the National Park Service being considered in the Walnut Canyon study would be inconsistent with this standard that is included in all alternatives; however, any transfer of land management to another agency would require special legislation despite direction in the plan and is out of the control of the agency. Such an action would likely still result in protection of key archeological resources that were a public concern during previous forest plan discussions and Walnut Canyon studies. Similar land exchange limitations in the Sedona area require acquisition of land in the Sedona area if lands are conveyed through a land exchange. These limitations address local concerns about loss of NFS lands, but they may limit the ability to convey Federal lands for future community needs in this area. This direction does limit land exchanges that may acquire property in other areas of the forest or state and, therefore, may result in lost opportunities to acquire other key resource properties or inholdings that would benefit the NFS in Arizona and not just the local area.

Alternative A

Overall, the 1987 plan does not address concerns for community open space values that are now part of most local community plans. The 1987 plan identifies a classification system of lands with criteria for land acquisition and for base in exchange or lands available to convey and identifies lands appropriate for acquisition such as isolated inholdings, riparian, and threatened and endangered species habitat. The 1987 plan also includes standards that restrict land exchanges in the Sedona and Walnut Canyon areas in order to address public concerns and maintain valued forest lands in forest management. The criteria are detailed and somewhat repetitive and tied to conceptual descriptions of forest ownerships. Some important resources within communities or in large blocks of private land but still adjacent to the national forest, may not be considered important for acquisition under this criteria even though it may be highly valued for certain resources, like riparian corridors or water resources. As a result, the open space values; riparian resources; and more isolated threatened, endangered, or sensitive species habitats associated with these non-Federal lands may not be considered for a land adjustment case and could be lost to development under alternative A as they would not be consistent with criteria for acquisition.

The 1987 plan lists specific lands to acquire—many of which have been acquired since 1987. Other potential acquisition parcels are not listed and, therefore, may not be perceived as high priority, such as areas that contain the endangered cliffrose, *Purshia subintegra*. Parcels of importance change throughout

the life of the plan as resource values are discovered, such as archaeology resources, and identified, or additional plant or wildlife species are listed, identified or conditions change. As most of the communities within the Coconino NF boundary have a level of concern about potential land adjustments, especially land exchanges where Federal lands are conveyed, the 1987 plan only requires additional coordination and restrictions on land exchanges in the areas around Flagstaff and Sedona. Therefore, the direction in alternative A is too narrow and only directs more emphasis on coordination with certain local governments as opposed to a broader, more collaborative approach. This limited emphasis may result in distrust with other communities within the forest who were not specifically mentioned in the current direction, and therefore, not support adjustment projects.

Land and Water Conservation Fund priority direction for potential lands to be acquired is contained in the policy (Forest Service Manual 5420) and priority system (Forest Service Handbook 5409.13 Chapter 10), therefore, this wording is no longer needed in the plan. The criteria of lands to acquire are effective for determining potential purchase cases instead of a list of priority properties.

The 1987 plan states specific boundary and land line direction, but timeframes do not reflect current limitations in budget and the flexibility of the forest to determine priority work. As a result, this direction is unachievable.

Alternative B (modified)

Alternative B (modified) would include guidelines that describe characteristics of lands to be acquired or conveyed instead of identified as base-in-exchange (except Sedona) and a specific desired acquisition list. The criteria in alternative A are replaced with guidelines that are more focused on specific resources and less specific to location on the landscape. These guidelines would likely result in similar land adjustment cases to the 1987 plan, except for less emphasis on land adjustments that would result in more consistent or efficient forest management. For example, non-Federal inholdings (parcels surrounded by NFS lands) that do not contain key resources like endangered species or archeological resources or are located nearby are not emphasized for acquisition. While these parcels do not include key natural resources that are specifically identified for possible acquisition in these alternatives, potential development of these parcels may result in other changes to surrounding NFS lands. The need for year-round access could result in either improved, paved roads, changes in recreation experience, watershed impacts on unimproved forest roads, and disturbance of wildlife species or fragmentation of habitats as a result of private land development within the forest. Non-Federal land development of inholdings can result in increased costs and difficulty of managing fires and other management activities within surrounding forest, including conflicts with other forest users, limitations on recreation uses or access, or increased access to areas typically closed during wet weather conditions. However, alternative B (modified) does not emphasize acquisition of these types of inholdings unless it includes the key resources identified in the guidelines such as habitat for threatened, endangered, or sensitive species. Non-Federal inholdings had a higher priority for acquisition in the 1987 plan criteria. Removing base-in-exchange also removed direction to limit treatment and other resource activities on parcels that were identified as base-in-exchange. Eliminating this restriction allows for fuel treatments and other management activities on parcels near communities to better achieve vegetation or community fire plan objectives.

Alternative B (modified) would identify open space values to be retained as a desired condition. This statement could be interpreted by communities and neighbors as any NFS land they consider valuable for their open space. This could make land exchanges even more difficult and more restrictive in some places where communities use this desired condition to preserve NFS lands adjacent to communities for open space purposes. Working collaboratively with local governments and communities early on the land exchange projects per the associated management approach may result in land exchanges being developed

that meet community and forest needs and parties agree to potential tradeoffs of open space values for other resource benefits.

Alternative B (modified) would continue to allow for conveyance of lands to meet community and public needs and adds loss of wildland character to the list of lands that could be conveyed. This could provide incentive for non-Federal neighbors to protect those values to reduce potential for land exchange or sale. This alternative also adds forestwide emphasis to management approaches for collaboration with private landowners and local governments to protect forest values from adjacent development impacts. This could result in less habitat fragmentation and greater watershed health to forest resources from adjacent non-Federal uses by developing buffers on private lands. The Walnut Canyon and Sedona areas land exchange restrictions, however, are retained as is and its consequences are the same as alternative A (the 1987 plan).

Alternative B (modified) removes the specific list for Land and Water Conservation Fund purchase projects. However, it does not change implementation of that program from the 1987 plan; it only eliminates outdated direction. Characteristics of lands to acquire are stated in the guidelines and priorities are set using a ranking system in the Forest Service Handbook.

Boundary survey and encroachments are not specifically mentioned in alternative B (modified), but they are still part of a lands program and would be addressed according to policy and regulation and should not change current management.

Overall, alternative B (modified) is not substantially different from the 1987 plan, and adjustment guidelines and desired conditions reflect more succinctly the criteria of lands desired for Federal acquisition and those appropriate for conveyance. Open space values are included to address local concerns about land exchanges that result in conveyance of NFS lands. Loss of wildland character as a conveyance characteristic is a good communication tool with adjacent non-Federal owners who can work to protect those values, perhaps reducing encroachment cases. This desired condition allows for communities to identify important open space, and it also encourages communities to take some responsibility for preserving wildland and resource values. Specific direction for land exchanges in the Sedona area and Walnut Canyon have been retained, so there is no difference from the 1987 plan, but restrictions have not been expanded beyond these areas. Other land adjustments, particularly those for public or community purposes, would continue to be allowed under these alternatives as in the 1987 plan. If land adjustment actions are consistent with the guidelines, key resource value properties would be acquired and would result in meeting the desired condition of a mostly contiguous land base that provides for biologically diverse public lands.

Alternative C

With respect to landownership management, alternative C is not substantially different from alternative B (modified). The only exceptions would be where the East Clear Creek and Deadwood Draw recommended wilderness areas are adjacent to private property. Wilderness designation could limit land exchange or other land adjustments in these areas if there were encroachments or other issues or needs related to those lands of other ownership that could not be resolved within the recommended wilderness areas.

Alternative D

Alternative D is the same as alternative B (modified).

Special Uses

Common to All Alternatives

Encouraging maximum use of existing utility corridors and communication sites is common direction to all alternatives. Combining and expanding uses along existing corridors or at existing sites results in keeping impacts to places where uses exist already. Additionally, consolidating impacts of new uses on scenery, recreation experiences, and wildlife habitat could reduce impacts of uses to potentially smaller areas of the forest (1987 Plan, pages 79 to 80); FW-SpecUse-G-4, 5, 6 and 8). These guidelines direct potential land use applicants to locations already impacted versus creating new facilities in new areas. Uses should primarily remain in places that already have impacts, thus preserving undeveloped settings and scenic resources as well as reducing impacts to other resources such as soils, watersheds, and wildlife habitat and connectivity in remaining areas of the forest. There is potential that this guidance will not meet utility and communication needs and public expectations where new facilities are needed outside of existing corridors and sites. Plan amendments may be necessary to meet National Energy Policy and the National Telecommunications Act for potential new or expanded sites and utility corridors. Climate change and the potential increase in fire activity or tree mortality may increase the needs of utility companies (in particular those with aerial lines) to invest more in removing hazards or in repairs to facilities. This activity may also result in more open areas adjacent to these corridors and the inconsistency with scenery objectives of the linear look along utility corridors.

Alternative A

Specific special-use direction on processing has been changed in policy and regulation since the 1987 plan was implemented. Some direction and terminology contained in the 1987 plan is no longer consistent with current regulation and screening criteria. Current regulations and direction would need to be followed to provide a legally defensible special-use permitting process. Therefore, the current direction in alternative A may create conflicting direction that would make approval of some special uses more difficult.

The 1987 plan included an appendix of approved communication sites and specific uses—no new sites or different uses were permitted on a site without a plan amendment. This direction is restrictive without considering whether resources were impacted by a proposed tower, facility, or use, and does not address the more recent demands for wireless communications facilities and the public demand for those services in all places. The need for forest plan amendments adds more complexity and slower timelines for approval of new facilities and uses, and therefore, is less consistent with Telecommunications Act of 1996, which requires facilitation of communication facilities where consistent with the agency mission and planned uses. For instance, wireless communication facilities tend to be more frequent and not require mountain tops like traditional radio sites were when the plan was developed. These uses are more in demand and are not well addressed with the current forest plan direction or specific site list, nor does this meet the Telecommunications Act policy direction to facilitate these types of uses when it requires a plan amendment process. Project-specific forest plan amendments are required to allow a new communication site or to change the type of use on an existing site even if there were no resource-specific concerns in an area. While this was intended to minimize new sites and limit impacts to scenery on mountaintops or in other areas, it does not address the continuing demand for telecommunications and expansion of those services, particularly wireless communication services and the changes in technology that could mitigate resource concerns with different locations and scale of equipment. Current Forest Service Handbook direction also encourages the use of existing sites and facilities prior to consideration of new sites to limit new facilities unless there is a strong need.

Utility corridor direction encourages maximizing the use of existing corridors before looking at new ones. The 1987 plan has larger areas with a modification (or low) scenic integrity objectives. Therefore, new

corridors could be considered in broader areas in alternative A; however, they would still be limited by other resources, such as wildlife habitat and research natural areas. Alternative A may allow for easier placement of new utility corridors without a plan amendment; however, other sensitive resources are widespread on the forest (e.g., wilderness, archeological resources, special status species); thus, new corridor locations would still be somewhat limited under this alternative.

The 1987 plan allows for project-specific degradation of scenery by one visual quality objective classification level without a forest plan amendment, and it offers flexibility in allowing transportation and utility projects in areas where these projects would not meet scenery direction. This would facilitate approval of projects without the additional forest plan amendment process as long as other resource objectives were met, but it would have a continuing effect on declining overall visual integrity in project areas. However many of these situations are located in areas along highway corridors where scenery is valued, but other safety factors are of higher importance and development is expected.

The 1987 plan (page 18) also provides direction on the priority of processing right-of-way grants for public purposes and limiting private access to one route serving all owners of that parcel, which is consistent with special uses policy. Only allowing one access route into private land limits impacts to resources on the surrounding NFS lands to one spot, while still providing the needed access to private land. Scenery values and wildlife habitat and connectivity are better protected around the parcel by only allowing a single vehicle access point. However, secondary access for emergency situations may not be met with this policy and could result in safety concerns related to direction like the Firewise program for residential development within and adjacent to the forest. Overall, the 1987 plan provides direction on suitable places for special-use permits and a goal for special uses meeting the needs of communities and the public. It encourages working to approve uses that meet the needs of expanding communities, while minimizing impacts to other resource values by locating special uses to avoid threatened and endangered species habitat, cultural resources, and scenic areas or reducing impacts where possible. It contains some limitations and specific lists that have not been kept up to date. Special uses policy and procedures have been revised since the 1987 plan, and now provide some of the more specific screening and processing direction. Scenery objectives throughout the forest allow more places for visible structures or facilities than alternatives B (modified), C, and D, therefore, allowing for larger areas where new uses could be considered without impacting scenery values. Flexibility to drop scenery objectives one level for a specific project allowed for uses to occur that had visual impacts, but could be mitigated to an extent.

Alternative B (modified)

Alternative B (modified) retains much of the special uses direction from the 1987 plan and includes direction that allows uses when they are compatible with other resource objectives. However, stronger objectives for scenic quality across the forest would result in more restrictions on future utility corridors and other larger scale uses, limiting them mostly to existing corridors. This would result in protection of scenery values over more areas of the forest and less infrastructure development potential away from existing corridors. Changes to wildlife habitat would be limited to around existing facilities, reducing potential for habitat fragmentation in other areas where there is not current utility development. Expectations of structures within roadway corridors, including potential wildlife crossings and other roadway facilities, address the conflict between the valuable scenery resources along major roadway corridors and the need for facilities associated with roads. This allows for development of safe roadway corridors as well as opportunities to develop wildlife crossings or other visible structures to help reduce highway corridor-related barriers to wildlife movement. New and expanded corridors and other special uses that include larger acreages would be limited under the stronger scenery direction in alternative B (modified), but they would better protect scenic integrity values across broader areas of the forest. Alternative B (modified) contains more specific direction and desired conditions that describe where special uses can be compatible with other resources than the 1987 plan. Alternative B (modified)

emphasizes characteristics of areas where special uses can be considered when needed by the public instead of leaving evaluation of resources to processing of proposals. Special uses screening criteria and application processes in the regulations now address some specific direction that was included in the 1987 plan and, therefore, do not need to be included in alternative B (modified). Use requests can still be considered; however, they may be more restricted under this alternative, but allow other resource conditions and objectives to be better achieved.

Guidance on infrastructure, utilities and roads, and scenery values in alternative B (modified) is more specific than the 1987 plan. Most of the forest is designated with high or moderate scenic integrity objectives; therefore, most new large-scale utility corridors would not meet these objectives so would not be considered without a forest plan amendment. Low scenery objectives along many existing power line corridors could allow for future expansion as well as mitigating other resources. Maximizing use of existing corridors is carried forward from the 1987 plan with some additional limitations in areas of moderate scenic quality such as by West Clear Creek Wilderness and in the Walnut Canyon Management Area. By maximizing use of existing corridors and allowing expansion along those existing corridors, existing recreation experiences would not be changed, wildlife habitat loss would be reduced, and facilities would be consolidated to confine development and management needs to smaller areas of the forest. This would consolidate locations that would need fire protection during prescribed and wildland fire activities where possible.

Additional direction for corridors is similar to that in the 1987 plan by placing needed facilities in places that reduce ground and vegetation disturbance and minimizing effects to multiple other resources (e.g., archeological sites, wildlife habitat, and water quality) while recognizing the public needs and demands for reliable energy and communication services, as well as for transportation and other infrastructure associated with growing populations and communities. Use requests that affect smaller areas could be allowed in less visible places that could meet scenery objectives and limit loss of wildlife habitat or disturbance to wildlife species.

Alternative B (modified) contains less specific direction on communications without a list, but relies on a broad public need being demonstrated in order to avoid communication facilities becoming too frequent, dominating forest landscapes, degrading scenery, and impacting other resources from the additional ground disturbance. Alternative B (modified) does not contain an inventory of electronic sites, and therefore, includes slightly less specific direction on communication sites; however, with Forest Service Handbook direction for communication site uses and screening criteria, applications for new sites would be treated similarly to alternative A to meet public needs and reduce resource impacts (FW-SpecUses-G-5, 8 and 10). However since these types of sites are typically visible and may not meet scenery objectives, forest plan amendments and more complex screening of this type of use request would be likely. Adding more complexity to these proposals may not be as consistent with the Telecommunications Act. Since technology continues to change, locations for these types of uses cannot be easily identified for the long term and would be appropriate to consider on a case-by-case basis to consider locations instead of identifying appropriate locations in the forest plan.

Research permit direction in alternative B (modified) is strengthened to provide a stronger focus, but also to indicate when those activities are appropriate on NFS lands and have national forest values. This addresses concerns about the forest being more supportive of research activities, but clearly indicates that the forest would be more supportive of research that relates to the mission of the Forest Service and would not affect recreation opportunities or impact vegetation structure and composition and management objectives in the long term. Such guidance would clearly articulate and narrow the types of research the forest would consider permitting and support research projects that benefit the agency as well as the sponsoring research organization, while reducing equipment and other infrastructure installation that

could be inconsistent with recreation experiences or scenery objectives, social trail development during access to research sites, and costs of fire protection of research plots or improvements in the forest from permitted research activities.

Direction on impacts to scenery allows discretion on wildlife crossing methods, including overpasses, when wildlife connectivity would benefit and potentially reduce some existing wildlife movement barriers along highway corridors as improvements are planned. This provides for a better working relationship with transportation agencies and provides more opportunities to address existing wildlife barriers.

The three recommended wilderness areas (RWAs) under alternative B (modified) (Strawberry Crater, Davey's, and Abineau) would result in minor new area limitations (an additional 8,733 acres) on potential new or expanded special uses and includes more acreage with primitive setting recreation objectives. However, these designations protect the primitive recreation experience and other wilderness values in these areas.

The expansion of Strawberry Crater and the Davey's RWAs would further limit the expansion or utility additions along the Western Area Power Administration (WAPA) power line corridor on the recommended wilderness side of the corridor. However, the proposed boundaries are located 210 feet from the existing power line to reduce potential impacts to vehicle access and vegetation management activities along the existing corridor and allow minor expansion or activities. Additionally, the proposed boundaries are adjacent to existing road access and could restrict access if future conditions would warrant relocation of the road access, especially near the Davey's RWA proposed boundary and Forest Road 9D where topography could be limiting as well.

Abineau RWA is not close to existing permitted uses, but could limit any new uses in this area, such as research permits that are common around the diverse setting of the San Francisco Peaks.

Alternative B (modified) provides more specific direction than the 1987 plan for inventoried roadless areas (IRAs) including emphasis on retaining their roadless character (SA-IRA-DC-1, SA-IRA-S-1) and restricting road construction and timber harvest in these areas. However, this direction is consistent with current national policy, so it would not change current management of these areas. Therefore, like in alternative A, management in these areas would remain mostly undeveloped to retain the roadless characteristics and limiting most new uses in these areas that would require any motorized access or would impact roadless character.

The designation of Rocky Gulch Research Natural Area, expansion of the San Francisco Peaks Research Natural Area, and designation of Cottonwood Basin Botanical and Geological Area would not affect current special-use activities, but the designation of Rocky Gulch Research Natural Area and the fumeroles areas could limit future special uses in those areas to those that are consistent with the purposes of their designation, such as research in the research natural areas. In the Cottonwood Basin Geological and Botanical Area, access would be limited to foot traffic, further reducing opportunities for some types of uses over alternative A, which does not specifically identify this combined special area.

Climate change could result in an increase in fire occurrences and tree mortality at the edges of certain tree species ranges, and therefore, increase investment of utility companies (in particular those with aerial lines) in removing hazards or in repairs to facilities. This may also result in more open areas adjacent to these corridors and the need to treat the adjacent edges to reduce the linear look and soften the corridor to better meet scenery objectives

Alternative C

Alternative C is similar in other effects to alternative B (modified). Additional recommended wilderness could restrict management of existing authorized uses and could limit new uses. The recommended wilderness areas cover large areas adjacent to highway and utility corridors and would limit any potential expansion of these corridors and some maintenance activities that may prove difficult for permit holders in these specific areas. This alternative may limit the forest's ability to meet the needs of the public, especially utility companies and Arizona Department of Transportation, to manage or expand their facilities for existing and future public needs.

The 13 new RWAs in alternative C would limit any new special-use permits and would restrict motorized and mechanized activities associated with existing authorized uses on the edges of these areas.

Davey's, Strawberry, and Abineau RWAs would have the same effects as alternative B (modified).

Barbershop, Cedar Bench, East Clear Creek and Railroad Draw RWAs do not have any current special uses; however, designating these areas could restrict expansion of existing uses or location for new land uses since any installation of equipment or structures would be nonconforming and, therefore, not likely to be authorized. Along the boundary of some recommended wilderness areas, there would be limits to development of future infrastructure, including expansion of nearby utility corridors as stated above. Arizona State Trust land adjacent to the Railroad Draw RWA could ultimately be auctioned and developed. This could impact wilderness values along the south side of the non-Federal boundary and create a difficult management situation with conflicting uses and would limit locations for future road and infrastructure to this parcel. Barbershop (1,310 acres) and East Clear Creek (2,035 acres) RWAs are already inventoried roadless areas (IRAs) and have had limits on road construction under current roadless policies. Thus, potential uses under alternative C would be restricted similar to alternatives A and B (modified); however, wilderness designation is decided by Federal law, which is more limiting than roadless policies. Acreage of Barbershop and East Clear Creek RWAs is similar to the IRA acreage for these areas.

Black Mountain, Cimarron-Boulder and Hackberry RWAs are adjacent to each other with the Highway 260 corridor and Fossil Creek Road (FSR708) separating them and within 200 feet of the highway corridor in some areas. If all are designated, Forest Road 708 would remain open and be excluded as a corridor between the wilderness areas to allow for continued access to the fiber optic line along the road, transmission power lines, the power substation, other utility corridors, recreation facilities and private land in Fossil Creek and the Childs area. Maintenance of the fiber optic line could be limited, depending on the proximity of the wilderness boundary. If the road locations for Forest Roads 708 and 502 in these areas do not remain stable and there is a need to relocate or reconstruct sections for safety reasons, there would be a limited ability to realign the road and fiber optic line due to the wilderness recommendations. The fiber optic line is very important in maintaining communication services for the communities of Strawberry and Payson, and would be very expensive to relocate.

Cimarron-Boulder and Black Mountain RWAs are also located on both sides of the Highway 260 corridor. Designation of wilderness to within 200 feet of the existing highway right-of-way would limit any future expansions, widening, or slope work beyond the 200 feet. Arizona Department of Transportation (ADOT) activities relating to their 13 Mile stockpile permit area and any future expansion needs for the Highway 260 corridor may be restricted if improvements were needed beyond the 200-foot buffer and would not be allowed within the RWA boundaries. This could limit the ability of ADOT to mitigate safety hazards and maintain drainages that support road stability if the need extended beyond the buffer. In addition, the boundaries of Hackberry RWA follow the Western Area Power Administration and Arizona Public Service's power line corridors in this area, possibly reducing the ability to access power line towers in this difficult terrain if needed in the future. This could result in access concerns where these RWAs combine

near the Davey's RWA and create a narrow corridor along the Western Area Power Administration's transmission power line and Forest Road 93 access. However, current IRA direction in the alternatives A and B (modified) for Hackberry, Cimarron and Boulder IRAs would restrict roadway development and impacts to roadless character; therefore, restrictions would not be substantially different from wilderness designation proposed in alternative C. The difference would be that the RWAs, if designated, would be managed under Federal law instead of Federal policies for the case of IRAs, which Federal policies are subject to change. Alternative C includes more acres for RWAs than IRAs: 7,058 acres more in Hackberry RWA (24,931 RWA acres versus 17,872.9 IRA acres) and 5,274 more acres in Cimarron – Boulder RWA (15,124 RWA acres versus 9,850 IRA acres). Therefore, alternative C would restrict 12,332 more acres in roadless characteristics and future permit or land use activities than alternative B (modified)**.**

Deadwood Draw RWA has power and communication corridors no closer than 210 feet of the recommended boundaries and is near private property. Maintenance and access to these utility corridors could be limited by a wilderness designation. However, these limitations would be unlikely due to the distance from existing corridors, and therefore, should not impact public utilities reliability in the area but could limit future expansion in these areas. Access to private land is at the RWA boundary along the north side and designation could impact that access if the current access is impacted by floods or changes in the creek location or would limit any relocation to the south. In addition, access for maintenance of utility lines that serve this non-federal parcel could be restricted by this designation. Other future land uses would also be limited if the RWA is designated.

Tin Can recommended RWA boundary is within 210 feet of the edge of the Western Area Power Administration power line corridor and 200 feet to the south of the Highway 260 corridor. The access road for this power line is near the RWA boundary. Vegetation management activities associated with the power line may occur outside of the right-of-way when hazards exist, and wilderness designation would require minimum tool use (potentially use of crosscut saws or other tools to remove hazards) or exceptions to allow for use of mechanized equipment for safety or resource purposes. The 210-foot buffer would likely reduce the potential for these issues. Road access would likely not be impacted by designation. Impacts to future highway expansion or slope work would be limited on the side of the highway adjacent to the RWA boundary to no more than 200 feet from the highway corridor.

Walker RWA could limit locations of any new north/south utility corridors, although the existing West Clear Creek and Beaver Creek Wilderness areas to the south and north, respectively, already limit the potential for a new or expanded corridor in this area. An irrigation ditch easement in Walker Creek one-third of a mile east of private property could be close to the RWA boundary. If the diversion is located in recommended wilderness, maintenance and the diversion facility and concrete ditch would likely be a non-conforming use. Recommended boundaries would need to be identified to determine whether infrastructure is outside of the wilderness. No other existing uses would be impacted, but any new uses would not be allowed. Since the area of Walker RWA is already an IRA, consideration of new uses would not likely be substantially different than current management and the alternative B (modified) and the acreage is the same as the Walker IRA.

When vegetation management of existing infrastructure is difficult to access, the additional restrictions associated with alternative C could result in conflicts with the National Energy Policy, which directs the agency to facilitate reliable power resources that could be threatened by hazardous vegetation. Power utilities would have increased costs of vegetation management activities due to limits on access or closed administrative use roads. Highway corridors in areas of growing populations are typically expanded within the existing corridors and alternative C's 13 RWAs could restrict Highway 260 expansion needs in the future. The landownership pattern of the Coconino NF, including existing wilderness areas already limits many new potential travel routes. Designating new wilderness adjacent to existing corridors does

not allow for expanding roads to meet higher traffic numbers and address safety, or to construct facilities such as wildlife crossings, improved drainage structures, or slope stabilization structures beyond 200 feet of the corridor that may become necessary in the future.

There are changes and additions to management areas (MAs) in alternative C, including a modified Anderson Mesa MA and seven new management areas (Hospital Ridge, Jack's Canyon, Knoll Lake, Pine Grove, Second Chance, Limestone Pasture and East Clear Creek) that have a focus on reduced human-related disturbance and also emphasizing more primitive settings in steep areas and canyons in other adjacent management areas. Over time, these new MAs could result in reduced public motorized access, including for potential new special uses. The three watershed management areas in alternative B (modified) (C.C. Cragin, Lake Mary, and Inner Basin) are not included and areas are incorporated into other management areas of alternative C. However, protection of watershed resource is included in the desired conditions in most of the new management areas. The San Francisco Peaks MA under alternative C does not include any guidelines related to protection of water, watershed, or riparian/springs as in the alternative B (modified) Inner Basin MA guidelines, and therefore, does not address concerns about protecting City of Flagstaff water infrastructure and water resources in this area. There is also an additional management approach for the San Francisco Peaks MA to continue to work with City of Flagstaff to minimize impacts to forest resources and to rehabilitate impacted areas. There is a desired condition (MA-Peaks-DC-4) that is revised in alternative C to identify additional access restrictions on Forest Road 146 (Waterline Road), Forest Road 6437, and the portion of Forest Road 553 from Lockett Meadow to the Waterline Road for City infrastructure operations than alternative B (modified). There is a different boundary for the Anderson Mesa MA, but direction is similar. Additional management areas and the management of these areas should not result in impacts to existing permitted activities and do not preclude consideration of new permitted activities. Although the new management areas emphasize reduced vehicle use, reduced roads and protection of wildlife habitat could restrict new uses that require vehicle access or have potential to impact wildlife habitat and connectivity, as this would be inconsistent with guidelines and objectives in alternative C and the new management areas. Access for existing uses is not likely to be impacted except if road density limitations result in road closures that have been used as access to existing or new uses. Consideration of mitigation measures to minimize impacts to wildlife species and their habitat, including extent of road access, would be considered as part of specific permit actions or consideration of new permits or permitted activities. Stronger emphasis on certain wildlife and road densities and decommissioning may result in limitations of new uses or in management of existing utility corridors in these management areas.

Alternative D

Alternative D has similar effects as alternative B (modified) for existing or new special uses. The only difference is that alternative D includes designation of the 185-acre Cottonwood Basin Geological Area only, with no designation of the botanical area that is included in alternatives B (modified) and C. In addition, alternative D effects are the same as alternative A for recommended wilderness, as it does not recommend any new or additions to existing wilderness areas (retaining 8.2 percent of the forest in wilderness). Therefore, alternative D reduces the acreage where there might be limitations on new permits or access for permit activities compared to alternative B (modified), because it would not include the 8,733 acres of recommended wilderness and 578 acres of botanical area.

Alternative D includes an additional management approach related to scenery for the forest to work with proponents to find a location with a moderate scenic integrity objective or lower when management activities or permitted uses conflict with high or very high scenic integrity objectives. This would help protect the scenic values within these areas. Other effects related to opportunities and access for new special uses are the same as alternative B (modified) related to RNAs, IRAs, and climate change.

Cumulative Effects

The cumulative environmental consequences are spatially bounded by an area larger than the Coconino NF's proclaimed boundary, generally the area immediately adjacent to the forest. Influences on occupancy and use of NFS lands come from outside of the immediate area. Energy corridors are typically linked into the western United States grid. Communications sites and transportation systems service areas may include northern and eastern Arizona or the entire state. Continued population growth in the communities within and surrounding the forest, as well as the state of Arizona, influence landownership adjustment cases, boundary issues, and the demand for special uses. Some specific projects and other agency plans are stated below. This analysis of cumulative effects considers foreseeable activities over the next 10 to 15 years.

Landownership, Boundary Management, Land Adjustment, and Right-of-Way

Continued population growth in all communities within the Coconino NF and in the West is expected and would add to the demand for additional lands for development purposes, especially infrastructure. Communities that have not planned for additional infrastructure needs would likely request acquisition of NFS lands for infrastructure, such as expansion of water treatment facilities and other waste systems that are not appropriate under permit. Examples of these kinds of requests include: (1) the city of Sedona planning for further needs for their waste water system, including new wetlands with public uses that might include access or viewing platforms on the national forest, and (2) the city of Flagstaff also continues discussing airport expansion and their continued desire for acquisition of NFS lands in that area.

The natural surroundings of the Coconino NF contribute to the preservation of dark skies. Four observatories exist on the Coconino NF and adjacent lands, including the new Discovery Channel telescope. Increased light pollution is a consequence of population growth and development in the dark sky areas surrounding the observatories. If the predicted trends of increased development occur in the area, there could be a loss of dark skies within communities. At the same time, there is an increasing demand for more developed and undeveloped night sky viewing opportunities on the Coconino NF, including expansion of Lowell Observatory's facilities at Anderson Mesa.

There are approximately 39,900 acres of State of Arizona land within the Coconino NF. While five state parks (Slide Rock, Red Rock, Fort Verde, Riordon Mansion, and Dead Horse Ranch State Parks) are located within the forest boundary, the majority of State-owned lands are Arizona State Trust Lands. State Trust Lands have the potential to be leased for uses or auctioned for development purposes. Current economic trends have resulted in fewer auctions, with most of the activity being in the Phoenix metropolitan area and not in rural Arizona. State Trust Lands within the Coconino NF boundary are mostly used for grazing and other lease uses. State lands in other areas have been recently leased for wind energy turbines.

There are four national monuments within the Coconino NF boundaries. All have influenced forest management in some form. Sunset Crater Volcano and Walnut Canyon National Monuments manage facilities and roads on the forest and are considering expansion or acquisition of additional lands into their management. Walnut Canyon took over management of some NFS lands in the early 1990s and a current study is under way to evaluate further additions to the monument. The expansion of facilities on the Coconino NF proposed by Walnut Canyon and Sunset Crater Volcano National Monuments may result in a continued need for coordination or potential interagency land transfers in the future. Montezuma Castle National Monument has acquired land through a legislated land exchange process and continues to encourage the forest to acquire additional lands around their boundaries as well as protect adjacent NFS lands.

As private properties, especially inholdings, change from ranch or undeveloped land to subdivisions or higher density uses, encroachment into NFS land becomes more frequent, resulting in resource impacts such as introduction of non-native plants, soil compaction, loss of native vegetation and possible loss of wildlife habitat and damage to archeological resources and land survey needs to determine the extent of forest impact.

All community plans now address open space as required under State law. Most of the incorporated communities within the Coconino NF boundaries include large acreages of NFS lands within their incorporated boundaries and identify these lands for their open space values to the communities. As communities grow and infill occurs, undeveloped lands and their open space values are converted to residential or commercial uses. This growth would likely result in continued pressures to maintain NFS lands for their open space values. This may also trigger the need to acquire right-of-way in places where informal public access is lost to development.

Cumulatively, continued growth in communities as shown in the census numbers and the resulting demands for acquisition of NFS land tend to move the forest away from desired conditions of natural open space adjacent to communities. As further development occurs, residential encroachments onto the national forest are expected to occur more frequently and degrade wildland character and other resource values. Working with other governmental partners on ordinances and plans could continue to reduce potential impacts to forest resources by planning and creating buffers and reducing density of development adjacent to NFS lands, designating access points to the forest, creating a coordinated trail system, and having other government entities monitor non-Federal development to avoid encroachments. These activities reduce potential loss of habitat and soil compaction, damage to archeological resources, reduce changes to recreation experience or scenery, and reduce some potential for introduction on invasive species. All communities adjacent to Coconino NF recognize the open space and recreational values the forest provides and have developed goals and objectives in their plans to preserve these characteristics. Entities like the Nature Conservancy and Verde Valley Land Preservation Institute can assist in acquiring key parcels, particularly related to riparian and the Verde River that would help retain water resources and habitat for desired conditions for fish and other wildlife species.

There would continue to be tradeoffs of resource values on the Coconino NF as a result of expanding communities and their needs. There would also continue to be a tension between the desires to retain NFS land near communities and the need to provide land for infrastructure for community expansion. Local collaboration expectations with communities and their desire for open space may result in fewer statewide land exchanges and only localized exchanges. However, all alternatives acknowledge community needs and the locations where land adjustments are appropriate and minimize impacts to other resources. These cumulative effects are consistent among all alternatives.

Special Uses

Potential development of alternative energy resources outside of the Coconino NF, such as Clean Line Energy's Centennial West project and the Flying M Ranch wind farm, as well as the renewable portfolio standard adopted by the State of Arizona in 2006, which requires electric utilities to generate 15 percent of their energy from renewable resources by 2025, would likely result in a new utility corridor and potential solar or wind energy development proposals from energy providers.

Ongoing population increases also would likely result in demand for new transportation systems, mostly in road corridors. Potential changes to the transportation system can be anticipated through current studies and plans. The Verde Valley Multimodal Transportation Study recommends roadway improvements showing an extension of Beaverhead Flat Road as well as improvements to Montezuma Castle Highway that pass through the national forest. Recommendations also include parking areas for trails and park and

ride along level 1 concern roadways. These roadway improvements could result in impacts to scenery, recreation experience, access opportunities, range management, and wildlife and potential introduction of invasive weeds by creating new improved corridors that would increase traffic and be a higher standard roadway through land that is currently more primitive with little development nearby. The Arizona Department of Transportation Five Year Plans for the Flagstaff Arizona Department of Transportation District include corridor studies for expansion (adding lanes and interchanges) of both Interstate 17 and Interstate 40. These improvements would impact scenery resources by widened corridors, but also have the potential for addressing wildlife connectivity through the construction of wildlife crossings as improvements are constructed. Other travel corridor improvements would also be expected during the life of the plan. These construction activities have the potential to promote further introduction of invasive weeds along corridors and changes in scenery and recreation opportunities.

Inholdings and residential developments within and adjacent to the forest may also affect NFS lands. When inholdings of private property have gone through a lot-split process instead of a subdivision, access to individual parcels has not been provided for. This has resulted and would continue to result in additional road access requests and the potential for multiple access points and permits on the Forest. Subdivision developments may result in higher standard road access corridors to meet local government requirements. These higher standard access roads have the potential to move the area away from the desired landscape character for scenery, and impact wildlife habitat and recreation experiences.

Population growth in Arizona continues to place pressure on utility providers to ensure reliable services. This growth results in continued requests for uses that allow for redundancy or alternative feeds (wireless and other communications services, water pipelines, electricity grids, power substations, and gas pipeline circuits), as well as additional storage facilities like water tanks. Locations for new uses would be limited because of the desire for maintaining high or moderate scenic integrity objectives in most of the forest.

Decreases in available water due to climate change predictions and increased water needs for communities, such as Flagstaff and their acquisition of the Red Gap Ranch, would likely result in the need for new authorizations for pipelines. At the same time, climate change predictions that indicate increased potential for extreme flood events could result in additional requests from local governments for flood control structures on NFS lands to protect infrastructure or private property. Facilities and infrastructure could be more vulnerable to damage from an increased risk of uncharacteristic wildfire if weather changes result in higher mortality of vegetation.

As stated above under the Land Adjustment section, cumulative effects of population growth and other entities future plans would likely move the forest away from desired conditions for some resources, depending on the location and scale of development. Development of infrastructure on lands of other ownership within the forest in many cases result in connections being required on the forest, such as wind energy related power line corridors or water pipelines from new well fields. Identifying some existing utility corridors for expansion allows for some new infrastructure to address new demands, but may not be in needed locations, depending on the sources of power, water, or gas supplies. Continued growth would also likely result in the need for additional transportation corridors and other community infrastructure that are not currently known.

Livestock Grazing

Affected Environment

Livestock grazing has occurred on the Coconino NF since it was established. This use has changed dramatically in the last 65 years. During World War II and in the years following, substantially more livestock were permitted to graze on the forest than today, as well as there being many more ranchers with

permits on the forest. In 1940, permitted use[48] on the forest consisted of 19,073 head of cattle and horses, 40,789 head of sheep, and 42 hogs. In 2006, the permitted use was 16,606 head of cattle and horses and 4,684 head of sheep and burros for a total permitted use of 140,280 head months.

The most significant change has been in sheep numbers. In 1940, there were 40,789 head of sheep permitted on 16 permits. This dropped to 23,000 head of sheep on 8 permits by 1949, and to 11,000 head of sheep on 3 permits in 1965. In the mid-1980s the numbers dropped again, and in 2006 there were 6,500 head of sheep on 2 permits.

Besides the large reduction in sheep permits and numbers, the number of cattle permits has declined from 103 in 1940 to 30 in 2006. This reflects a reduction in the number of ranches in the area and the combination of allotments (93 allotments in 1940 to 39 currently). These combinations were made to improve management and make the remaining allotments more economically viable.

The total permitted use on the forest has decreased by half in the past 65 years. Most of the reductions occurred before the 1987 plan was implemented. Since the 1987 plan was signed, the number of permitted livestock on the forest has decreased slightly.

The number of livestock authorized to graze in any given year has varied, based on the conditions of each allotment. Over the last 10 years, continued drought conditions have resulted in the authorized amount of cattle and sheep grazing on the forest in a given year to be between 50 and 82 percent of the permitted numbers, with some allotments fully stocked and some not stocked at all (see table 70). Partial or complete non-use for resource protection (that is, drought, fire, grasshoppers) and partial or complete non-use for personal convenience have been the primary reasons for these reduced numbers. Some allotments on the forest are grazed seasonally and some are grazed yearlong. Seasons include the fall/winter/spring period and spring/summer/fall period. Grazing systems vary across the forest, but the vast majority of allotment management plans call for some type of rotational grazing. Livestock from allotments that are grazed seasonally on the Coconino NF may be placed on other public land allotments (such as Bureau of Land Management or Bureau of Indian Affairs), and State or private land for the other part of the year.

Permitted and annually authorized livestock numbers for all grazing allotments on the forest are based on the availability of perennial vegetation, which varies based on the ecosystem. Livestock grazing allotments within the central portion of the forest are made up primarily of high-elevation systems that range in elevation from 6,000 to 9,500 feet. The high elevation generally results in higher annual precipitation levels than are received in the southern portion of the forest. The average precipitation rate varies from 18 to 25 inches per year. Precipitation is primarily received yearly during the summer and winter. The summer period (July through September) is typically characterized by localized high-intensity, short-duration thunderstorms. The winter period (October through March) is characterized by frontal activity that generally results in widespread snow. The higher precipitation levels result in higher forage production, which allows for greater livestock stocking rates across these allotments.

Table 70. Permitted and annually authorized livestock use, grazing years 2004 through 2014[1]

Fiscal Year	Permitted Head Months	Annually Authorized Head Months	Percentage of Permitted Numbers Authorized Annually
2004	145,180	89,516	61.7
2005	142,317	89,410	62.8
2006	140,280	71,451	50.9

[48] The definitions for permitted use, authorized use, animal unit months (AUMs) and head months (HMs) are found in the glossary.

Fiscal Year	Permitted Head Months	Annually Authorized Head Months	Percentage of Permitted Numbers Authorized Annually
2007	138,056	81,307	58.9
2008	138,118	87,015	63.0
2009	134,990	99,815	73.9
2010	132,921	90,068	67.7
2011	126,500	103,222	81.6
2012	126,687	95,177	75.1
2013	128,841	98,412	76.4
2014	128,690	94,166	73.2

Source: Permitted numbers from district files and authorized head months are from annual bills for collection.
[1] Grazing year is March 1 to end of February.

The northern and southern portions of the forest occur at lower elevations that range from 3,000 to 7,400 feet. The precipitation rate varies from 8 to 15 inches per year. Again, precipitation is primarily received yearly during the summer and winter. The summer precipitation is similar to the central portion of the forest and the winter precipitation is characterized by frontal activity that generally results in widespread gentle rains and occasional snow. There are ERUs dominated by pinyon and juniper trees at elevations higher than 4,200 feet; while the lower elevation consists of semi-desert grasslands and desert shrub communities (USDA Forest Service 2009a). The lower precipitation levels generally result in lower forage production which results in lower stocking rates for allotments located in the lower elevation portions of the forest.

Of the 39 allotments on the Coconino NF, 33 are active, 2 are vacant (Lake Mary and Buck Springs) and 4 have been closed (Boynton Canyon, Ike's Backbone, Sedona, and Horse Mesa). The forest also has permitted use for one livestock driveway—the Beaverhead/Grief Hill Driveway—which currently has two permitted users. Since the inception of the 1987 plan, the Buck Springs and Walnut Canyon Allotments have had portions of their acres permanently closed from livestock grazing by decision based on resource protection. In addition, acres associated with the Walnut Canyon National Monument were closed by Federal legislative action. A total of 36,230 acres of land has been permanently closed since the 1987 plan was approved (table 71).

Currently, 29 livestock permittees hold term grazing permits on the Coconino NF: 28 cattle operators and 1 sheep operator. Some permittees operate on more than one allotment. The Lake Mary and Buck Springs Allotments are available for grazing, but are currently vacant because the term grazing permits were waived back to the Forest Service. The Lake Mary Allotment is a forage reserve and may be grazed by Forest Service permittees that need forage because of the need to rest pasture(s) on their allotment, primarily due to wildfire and/or prescribed burning. The Buck Springs Allotment was waived back to the forest and is currently vacant. This allotment will be reevaluated in the future for livestock grazing.

Table 71. Portions of allotments permanently removed from grazing

Allotment	Area (Acres)	Date of Decision	Notes
Buck Springs	24,120	8/18/2003	The record of decision closed the southern pastures that include headwater meadows and shallow drainages removed from grazing. This is included in acreage figure above for areas not within allotments. The reason for removing the pastures is to protect sensitive meadows and habitat for the Little Colorado spinedace (listed as endangered under the Endangered Species Act). These areas are no longer part of the allotment.
Walnut Canyon	7,397	7/28/2006	The South Newman, Walnut, and West Walnut Pastures were permanently closed to grazing. This was due to lack of water for livestock in two of the pastures and a need for protection of Newman Canyon.
Walnut Canyon NM	1,656	November 1996	Legislative action, section 206 of Public Law 104-333
Total	**33,173**		

A vacant allotment has zero permitted head months assigned to it, but can be reauthorized at a later date with appropriate site-specific environmental analysis. For the three vacant allotments on the forest, no term grazing permits are issued and, as a result, there are no permitted livestock numbers (zero head months). However, the forest may authorize temporary livestock use of these allotments if resource conditions on another forest allotment preclude livestock use (e.g., wildfire). A portion, or all, of the current vacant allotments may be returned to active status and a term grazing permit issued.

Current Management

Allotment evaluation analyses are conducted to determine if the desired conditions as set forth in the 1987 plan are being achieved. Also, a determination is made to evaluate if current livestock management is maintaining or progressing toward achieving desired conditions and if current livestock management is a significant factor in failing to achieve the desired conditions. Coconino NF rangeland specialists and other qualified resource personnel make regular site visits to grazing allotments to ensure compliance with the terms and conditions of the term grazing permit.

Since the approval of the 1987 plan, there have been numerous changes in and around the Coconino NF; primarily in the form of human population increases in the communities within and surrounding the forest. A direct result of the increasing population has been a substantial increase in recreational use of NFS lands, especially for off-highway-vehicle use. This has created conflicts with livestock grazing; especially in the southern portion of the forest planning area. Due to population encroachment from communities, adjustments had to be made to livestock grazing systems or rotations to compensate for the increased demand and general public interactions with livestock and livestock improvements. Also, increased off-highway vehicle and recreational uses such as camping, hunting, and hiking have resulted in additional disturbances to rangelands, which require further analysis to determine their effects on rangeland health.

Environmental Consequences

Due to competition with other resource uses (such as recreation, wildlife, and mining activities), forest permittees may not be able to maintain current range management practices (including range improvements) at the same level or manner as they have to date. Permittee livestock operations have a likelihood of change going forward. One of these changes will likely result in the reduction of motorized

access by permittees to various areas of allotments for range improvement maintenance, salting, herding, etc., to protect soils, vegetation, wildlife habitats, and other resources. It is not possible to estimate the effects to areas available for grazing or head months because site-specific information is not available to estimate their magnitude and scale. However, it is possible to describe what the outcomes would be where these impacts might occur. One such outcome could be the change in equipment the permittee uses for range structural and non-structural improvement maintenance, due to restrictions in such things as cross-country travel for herding or the restricted use of ATV/UTVs for fence maintenance. This would alter costs of maintenance activities in the future.

Common to All Alternatives

Under all alternatives, livestock grazing on the Coconino NF would potentially be affected by other Forest Service activities, such as vegetation treatments, prescribed burning, recreation, land exchanges, travel management, noxious and invasive weed management, and special designations. Potential consequences to livestock grazing and their effects to other activities, infrastructure, and resources on the landscape are summarized below. As a result, under all alternatives, adjustments in season of grazing, grazing intensity, kind and class of livestock, or type of grazing system could be necessary.

Implementation of the policies for grazing administration would be in accordance with the Forest Service Manual 2200: Range Management, and other policy and regulation. Rangeland assessments would continue under all four alternatives at the allotment scale to determine if the desired conditions are being achieved or moved toward.

However, due to the varying motorized vehicle restrictions of the alternatives, the mode of transportation used to carry out assessments and monitoring may differ by alternative.

If, through monitoring, it is determined that an allotment is not moving toward desired conditions, grazing management practices and/or current levels of grazing use would be modified in cooperation with the permittee; and a strategy would be implemented using adaptive management to restore the area to desired conditions. These policies allow for the maintenance or enhancement of vegetation, soil, and water resources desired conditions under all alternatives.

Consideration of grazing management during times of drought is addressed in the Forest Service Handbook and is not being repeated in the plan under any alternative. Drought guidelines for grazing permits on the Coconino NF are included in regional policy in the Region 3 Supplement to FSH 2209.13 Chapter 10, Permits with Term Status Section 19.1. These guidelines are broken into four elements: drought evaluation, management process, stocking during and after drought, and communication plan. These guidelines provide direction for grazing management during times of drought under all alternatives. These guidelines require the assessment of various attributes of the allotments, including the recovery of rangeland vegetation and other values provided by rangeland resource, such as wildlife habitat.

Renewable Energy. Under all alternatives, development of renewable energy would be allowed except in wilderness areas, recommended wilderness areas (alternatives B (modified) and C), management areas that are managed for reduced human-related disturbance (alternative C), or where effects (such as noise, vegetation removal, or surface disturbance) to scenery, wildlife, and other physical resources cannot be adequately mitigated to meet desired conditions and guidelines. Such development may, to a limited degree, conflict with current livestock grazing. These conflicts may include removal of grazing from specific facilities or area, construction of access roads and utility rights-of-way, and increased vehicle traffic in remote areas. Typically, grazing is compatible with wind energy production sites once the construction phase is completed. Its compatibility with solar energy production is less certain. Although some surface disturbances and vegetation removal may result from renewable energy development, such disturbances generally would be limited in magnitude and extent by resource considerations such as

wildlife or scenic resource concerns. Thus, the impacts (such as reduction of grazing area due to surface disturbance or vegetation removal) to livestock grazing from such development are expected to be limited, but it is difficult to estimate without any concrete proposals to evaluate. These impacts (reduced grazing area, surface disturbance, vegetation removal) associated with renewable energy source development activities would be mitigated to the extent practicable through management practices.

Alternative A

The plan direction for livestock grazing under alternative A is outdated and does not provide clear direction on obtaining rangeland desired conditions nor does the plan describe objectives to reach either properly functioning or desired conditions for rangelands. Alternative A describes a level of grazing management intensity (A through E) (1987 Plan, page 254), that is not tied to the management of desired conditions for range resources. The plan identifies outdated levels of use (1987 Plan, page 66-1) that are made invalid by site-specific information and monitoring. Guidelines in the amendment to incorporate the Mexican spotted owl recovery plan use an outdated range condition classification system. This outdated approach hinders implementation of adaptive management strategies through the site-specific environmental analysis, which includes consideration of such things as new range improvement projects, authorized season of use or kinds of livestock, and changes in the amount and kinds of forage permanently available. Furthermore, the Flagstaff-Lake Mary Area and Sedona Area plan amendments did not clearly define how intensity and use levels would apply within these management areas.

Alternative A requires that the forest conduct production/utilization surveys at least every 9 to 13 years (1987 Plan, page 67). The Forest Service no longer uses or conducts production/utilization surveys as defined in the old handbook. However, the Forest Service regularly (multiple times a year) monitors utilization and forage production. Forage production studies are conducted before environmental analyses are prepared on allotments.

Alternative A requires the assignment of permitted use and capacity only to those lands identified as full capacity (1987 Plan, page 67). This has created confusion because now the forest makes site-specific capacity determinations at the project level. Additionally, the Forest Service no longer uses the terms “full capacity,” “potential capacity,” and “no capacity.” The appropriate terminology has changed to “full capability,” “potential capability,” and “no capability.”

Although the current plan direction lacks comprehensive forestwide desired conditions for vegetation, existing law, regulation, and policy provide direction for managing livestock grazing and require the development of vegetative desired conditions, including understory vegetation, at the project level.

Plan direction for livestock grazing can impact other forest resources (e.g., reduced vegetative cover when implementing water developments (stock ponds, holding tanks with pipelines to troughs) or handling facilities (corrals, holding fields)); just as plan direction for other forest resources can impact livestock grazing management through introduction of timing or entry restrictions (such as restricted entry into specific areas that lead to reduced season of use, or area avoidance that reduces the area that can be grazed, etc.).

Plan objectives for watershed improvement are limited under alternative A, and the available objectives for soil and riparian treatments, road removal, and wildlife restoration are not reasonable to accomplish under current budgets. These current watershed objectives are not likely to result in substantial improvement of watersheds that are considered not properly functioning (1987 Plan, Appendix H). Even so, it is assumed the current levels of vegetation treatment would continue; and increase in some areas under Four-Forest Restoration Initiative implementation. Mechanical treatments could range from 53,900 to 272,900 acres for each 10-year period of the plan. Prescribed fire treatments could range from 158,000 to 208,000 acres for each 10-year period of the plan. Mechanical treatments at the low end, would be

subsequently treated by prescribed fire. Conversely, mechanical treatments on the high end (76,000 mechanically treated areas) would not be treated by prescribed fire. An additional 150,000 acres would be treated by managing wildfires for resource objectives for each 10-year period of the plan. (See Appendix C for the Assumptions Common to All Analyses and the Fire Assumptions in of the Vegetation and Fire section for additional details.)

A negative consequence, of meeting the upper ranges of the above objectives, is short-term changes to livestock use. This short-term change is a result of increasing the amount of vegetation treatments for most forest ERUs. Modifications of livestock grazing use would primarily occur after a significant prescribed burn in a pasture. However, if needed, pre-fire livestock grazing could be effected in order to retain surface fuels through pasture rest. This would ensure that there is enough surface fuel to meet prescribed fire objectives (i.e., more/taller grass = hotter fire, taller flame lengths = higher canopy base height, enhanced mortality of saplings/seedlings, healthier/more vegetation for grazing in the long term).

Post-fire grazing could resume in a pasture when soil and perennial forage or browse plants would not be permanently damaged by livestock. The range management definition for this is range readiness. Plants are ready for grazing when at least one of the following characteristics is present: (1) seed heads or flowers, (2) multiple leaves or branches, and/or (3) a root system that does not allow plants to be easily pulled from the ground. These characteristics provide evidence of plant recovery, high vigor, and reproductive ability. An estimate of entry restriction is not available because each pasture and burn is unique. Climatic conditions, soils, vegetation, burn intensity, burn amount, and pasture management can vary greatly from year to year or from pasture to pasture. Livestock grazing use could be authorized on other areas of the allotment or in vacant allotments temporarily; thus, not requiring livestock numbers to be reduced. The overall effects (e.g., open canopy, increased forage) would enhance the available forage on a long-term basis. The increasing forage productivity on treated areas would offset and later exceed future incremental reductions related to plan treatments.

Vegetation treatments and protection of freshly seeded areas would temporarily affect grazing on these areas until they were subsequently determined to be able to withstand grazing as defined above (range readiness); on the other hand, increased forage production on previously treated areas would offset temporary reductions within these areas. It is uncertain how frequently vacant pastures would need to be used as landscape-scale restoration projects are implemented, so effects to these areas cannot be estimated except on a site-specific basis. Alternative A would be positive for range resources in the long term due to increased herbaceous production, which would aid in livestock distribution and decreased competition for available forage.

The positive consequences for livestock grazing in meeting the upper range of the objectives for the Ponderosa Pine, Pinyon Juniper with Grass, and Mixed Conifer with Frequent Fire ERUs would be the long-term increase in understory vegetation; this includes forage species used by livestock and wildlife. Increased forage production, and thus, increased forage availability, could aid in improved livestock distribution through an area. When more forage is available, authorized livestock numbers are less susceptible to annual fluctuations; this would provide a more consistent stocking level for the permittees. Additionally, with more forage available, the forage utilization levels from authorized/permitted livestock use will decline. On the other hand, the positive consequences for meeting the lower range of the objectives for the Ponderosa Pine, Pinyon Juniper with Grass, and Mixed Conifer with Frequent Fire ERUs would be localized increases in both understory vegetation and forage production in treatment areas. The increase in forage production would be smaller than expected when the upper range is met, this also means livestock distribution would not be as great either.

There are four existing research natural areas (RNAs) within the Coconino NF planning area. These are the GA Pearson RNA, San Francisco Peaks RNA, Oak Creek RNA, and Casner Canyon RNA. See

appendix A, map 30. The GA Pearson Research Natural Area is located within the Fort Valley Experiment Forest, and therefore, is outside Coconino NF planning authority. The San Francisco Peaks Research Natural Area (1,010 acres) is located in alpine tundra, high in the Kachina Peaks Wilderness area. This RNA has been determined not suitable for livestock grazing (1987 Plan, page 110). Any livestock use on the small lowest elevation portion is slight to none, due to topographical features (specifically steep slopes) that make livestock access to the area difficult. The Oak Creek Research Natural Area (1,853 acres) and Casner Canyon Research Natural Area (609 acres) were also determined not suitable for livestock grazing in Amendment 12 (for the Sedona-Oak Creek Ecosystem) to the current forest plan. Amendment 12 closed these two research natural areas to livestock grazing. The Sedona Allotment that included the two research natural areas was closed in a subsequent 1998 decision. The area is inaccessible to livestock due to topographical features.

Three additional RNAs are proposed under alternative A. These proposed RNAs are West Clear Creek RNA, San Francisco Peaks Additions RNA, and Rocky Gulch RNA and have been determined suitable for livestock grazing. The three proposed RNAs would have the limited effects to grazing management as described below:

- **Proposed West Clear Creek Research Natural Area** (769 acres) See appendix A, map 30. This RNA is located entirely within the West Clear Creek Wilderness. It contains Pinyon Juniper Evergreen Shrub ERU, Mixed Broadleaf Deciduous Riparian Forest type, and a perennial stream. The far west portion of this proposed RNA is within the Buckhorn Allotment. Livestock use is slight to nonexistent because naturally occurring topographical features make it difficult for livestock to access the slopes and canyon bottom.

- **Proposed San Francisco Peaks Additions Research Natural Area** (135 acres on east side and 144 acres on west side of existing San Francisco Peaks Research Natural Area) See appendix A, map 34. Like the San Francisco Peaks Research Natural Area, the east side addition is located in Alpine Tundra and Spruce-Fir ERUs and is above 9,500 feet elevation, which has been determined to be not suitable for livestock grazing (1987 Plan, page 110 and appendix I). The west side extension contains bristlecone pine and Spruce-Fir and Montane/Subalpine Grassland ERUs. Livestock use on the west side extension is slight to nonexistent because naturally occurring topographical features (steep slopes) make it difficult for livestock to access the area.

- **Proposed Rocky Gulch Research Natural Area** (926 acres) See appendix A, map 30. is part of the Apache Maid Allotment. It contains unlogged ponderosa pine forest. Livestock grazing occurs at a low intensity because of low forage production and extensive historical vegetative experimentation in the watershed.

These areas were proposed as part of the 1987 plan, but have yet to be officially designated. Alternative A contains plan components that would require these areas to be managed to protect and maintain their uniqueness and ecological condition, when officially designated (1987 Plan, page 195). Alternative A would also require that allotment management plans have provisions to protect the uniqueness and/or ecological condition of these areas (1987 Plan, page 195). If grazing occurs in any area after designation, grazing management would be adjusted to ensure the area's uniqueness and ecological condition is protected and maintained. The plan language does not prohibit livestock grazing, but it may require more intensive management of an area with grazing.

Alternative B (modified)

Desired conditions in alternative B (modified) for livestock grazing would be beneficial for livestock grazing management, as described below. The evaluation of grazing allotments under this alternative would provide managers with updated plan components for developing allotment management plans

through a site-specific environmental analysis process. Environmental analyses on livestock grazing decisions are typically completed at the allotment level and may include consideration of new structural range improvement projects, changes to or retention of current authorized season of use or type of livestock, changes in available forage production, and changes in vegetation and soil conditions.

Alternative B (modified) places more emphasis on desired conditions for livestock grazing than alternative A. For example, a desired condition in the Livestock Grazing section states that permitted livestock grazing is consistent with the desired conditions of other resources (FW-Graz-DC-2). This plan component acknowledges that conditions immediately adjacent to livestock concentration areas, such as earthen stock ponds, developed springs, and other features that concentrate livestock, may be inconsistent with general desired conditions for vegetation and soil such as lower levels of vegetation and higher levels of soil compaction. Likewise, a Livestock Grazing guideline states that livestock grazing should be managed to meet or move toward desired conditions for forest resources such as soil, water, vegetation, and species (FW-Graz-G-2). By these references to other desired conditions, these plan components incorporate direction for other forest resources into livestock management decisions.

Thus, FW-Graz-DC-2 and FW-Graz-G-2 provide plan guidance to ensure livestock grazing management considers the understory vegetation that is necessary for ecosystem function within the natural range of variability (including extended drought). Alternative B (modified) addresses these evaluation criteria in several ways. The desired conditions for riparian types and terrestrial ERUs provide a description of desired composition and structure, which encompasses understory vegetation. For examples, see FW-Rip-RipType-DC-3, FW-Rip-RipType-DC-4, FW-TerrERU-Grass-DC-1, and FW-TerrERU-Grass-DC-3. Furthermore, understory vegetation in sufficient quantities is an essential ecosystem component in many fire-adapted ERUs as it ensures there is an adequate level of understory fuel to carry fire through the ERUs. Alternative B (modified) includes desired conditions that ensure native understory vegetation is capable of supporting natural fire regime (FW-TerrERU-Grass-DC-2, FW-TerrERU-PJ-DC-45, FW-TerrERU-PP-DC-1, and FW-TerrERU-MC-All-DC-1). Therefore, ensuring there are adequate levels of understory fuels to carry fire through these ERUs is essential for ecosystem function as well as reducing the risk of uncharacteristic wildfires. The desired conditions for other resources would be taken into account when applying FW-Graz-DC-2 and FW-Graz-G-2 to livestock grazing management decisions.

Alternative B (modified) also provides plan guidance to ensure there is enough understory vegetation available for native wildlife. Understory vegetation can support wildlife by providing forage and/or habitat. Alternative B (modified) includes desired conditions that ensure that projects provide for the physical and biological habitat components for wildlife in terrestrial ERUs and riparian areas (FW-WFP-DC-3 and 5). The desired conditions for wildlife would be taken into account when applying FW-Graz-DC-2 and FW-Graz-G-2 to livestock grazing management decisions.

Alternative B (modified) also includes plan direction for other forest resources such as fire, timber harvest, vegetation management that can affect the management of grazing livestock. During project implementation, actions such as prescribed fire or mechanical thinning could remove forage and require livestock to be moved elsewhere until adequate forage has returned to the treated area. Unlike alternative A, alternative B (modified) has express objectives for mechanical and prescribed fire vegetation treatment, as well as for wildfires managed for resource objectives (FW-TerrERU-PP-O-1, 2, and 3, FW-TerrERU-PJ-O-1, 2, and 3, FW-TerrERU-MC-MCFF-O-1, 2, and 3). Although these objectives are expressly stated, the assumed level of treatment under alternative B (modified) is expected to be the same as for alternative A because the expected budget and implementation of the Four-Forest Restoration Project is expected to be the same under all alternatives. Accordingly the effects and positive and negative consequences associated with these treatment levels and ERUs are the same as those described in alternative A.

Unlike alternative A, alternative B (modified) does not repeat the exact requirements of threatened or endangered species recovery plans. Instead, alternative B (modified) provides a guideline that states: Habitat management objectives and species protection measures from approved recovery plans should be applied to activities occurring within federally listed species habitat to promote recovery of the species (See FW-WFP-G-1). The revised plan under alternative B (modified) relies on this guideline to incorporate current and relevant direction from recovery plans. Accordingly, grazing management guidelines found in appendix C of the current Mexican spotted owl recovery plan (USDI Fish and Wildlife Service 2012b) would guide grazing management on the forest; and the outdated range classification system that is also embedded in the 1987 plan would no longer apply. The strategic nature of FW-WFP-G-1 ensures that when a recovery plan is updated, the language in the updated recovery plan supersedes any outdated language the forest plan repeated.

Alternative B (modified) proposes to designate 763 acres as a combined geological and botanical area to be known as Cottonwood Basin Geological and Botanical Area (Cottonwood Basin GBA). This combined geological and botanical area would overlap 611 acres of the Hackberry Allotment. The remaining 152 acres are not located in any allotment. Livestock grazing is deferred on 676 acres of this area until 2020. Therefore, differences in effects, by alternative, to the management of livestock grazing management will not change until after 2020. Desired condition #5 for botanical and geological areas state that the inherent physical and biological processes flourish and are not negatively impacted by human activities or permitted uses (SA-RNABotGeo-DC-5). Botanical and geological guideline #5 requires allotment management plans to include provisions to protect the uniqueness and/or ecological condition of botanical and geological areas (SA-RNABotGeo-G-5). Furthermore, livestock grazing desired condition #2 (FW-Graz-DC-2) seeks to ensure that permitted livestock grazing is consistent with other desired conditions, such as SA-RNABotGeo-DC-5. In order to meet or move toward the special area and livestock grazing desired conditions, livestock grazing may be adjusted to reduce the area available for grazing, construct additional range structural improvements (e.g., fencing, water systems), reduce numbers, or alter the timing of grazing within the portions of the Cottonwood Basin GBA found in a grazing allotment.

Three new wilderness areas, totaling 8,733 acres, are being recommended under alternative B (modified). The acres available for livestock grazing and head months permitted would be the same under alternative B (modified) as alternative A. Any livestock grazing that occurs before wilderness designation would continue under current management. Most of these areas are on land determined to be suitable for livestock grazing, with the exception of 1,973 acres in the Strawberry Crater recommended wilderness area that have been determined not suitable for livestock grazing.

Existing structural range improvements would continue to be maintained for livestock distribution and management that is compatible with maintaining the natural character of these areas. The Abineau, Davey's, and Strawberry Crater recommended wilderness areas have few structural range improvements or the structural range improvements they do have are located in easily accessible areas. Strawberry Crater recommended wilderness is located in a pasture deferred from grazing. The range improvements inside this pasture would need to be reconstructed prior to grazing reintroduction. In Davey's, most of the range improvements are located close to the boundaries, so their continued maintenance is unlikely to encroach on the area's wilderness character.

Motorized access for maintenance of existing range improvements in the recommended wilderness would not be permitted to expand. Neither would the use of motorized vehicles be allowed to increase in ways that would alter wilderness character. As a result, receiving permission to access these facilities by motor vehicle may require an additional analysis of the effects (ground disturbance of cross-country travel on fragile soils or vegetation) of motorized vehicles on the wilderness character of the area. New

requirements from this additional analysis would not eliminate the use of motor vehicles by permittees; it is very likely that where past use has been permitted, it would be able to continue. However, new structures and cross-country motorized travel within recommended wilderness would be more limited in alternative B (modified) than in alternative A. This is due to the fact that alternative A does not recommend any areas for wilderness designation. Any new structural range improvements needed for allotment management would be located outside of recommended wilderness unless the future maintenance of the structural range improvement can be done using the Congressional Grazing Guidelines in FSM 2323.22.

Fire and other natural disturbances would continue to maintain the wilderness character of the recommended wilderness areas in fire-adapted ERUs. Areas could still trend toward desired conditions for their associated ERUs if the fire regime is maintained through wildfire. Treatment of invasive plant species that unfavorably alter desired vegetative conditions could also be managed because invasive plants are considered a threat to the area's wilderness character when they pose a risk to the structure, function, or composition of the native plant communities (SA-RWild-DC-3). Active vegetation management and off-road travel would be limited by desired conditions that seek to maintain or enhance primitive and undeveloped characteristics and keep ecological systems substantially free of modern human manipulation (SA-RWild-DC-1 and SA-RWild-DC-2). Motor vehicle use would still be allowed. However, the type of equipment used for future improvement maintenance may change based on site-specific conditions because the recommended wilderness areas are not suitable for any type of new road construction (SA-RWild-G-3).

The four existing research natural areas within the Coconino NF planning area remain in alternative B (modified), as they did in alternative A. The effects of livestock grazing on these areas, as well as the effect of these areas on grazing management, are the same as discussed in alternative A.

Alternative B (modified) proposes two additional research natural areas and the expansion of one existing research natural areas. The Proposed Rocky Gulch Research Natural Area, is suitable for livestock grazing, but would have limited effects to grazing management for the reasons described below:

- **Proposed West Clear Creek Research Natural Area** (1,007 acres) is located entirely within the West Clear Creek Wilderness. While it shares the same name as the proposed research natural areas in alternative A, this proposed research natural area is farther up the canyon from the alternative A location. See appendix A, map 35. This area has been determined as not suitable for livestock grazing and is not within an active grazing allotment.

- **Proposed San Francisco Peaks Addition Research Natural Area** (135 acres on east side of existing San Francisco Peaks Research Natural Area). Like the San Francisco Peaks Research Natural Area, this addition is located in alpine tundra and is above 9,500 feet elevation, which has been determined as not suitable for livestock grazing and is not within an active grazing allotment.

- **Proposed Rocky Gulch Research Natural Area** (926 acres) is part of the Apache Maid Allotment. Livestock grazing occurs at a low intensity because of low forage production and extensive historical vegetative experimentation in the watershed. This area is also proposed as a research natural area under alternative A. Under all alternatives, livestock grazing would likely continue at close to current levels.

Alternative B (modified) includes several plan components that address grazing in proposed and designated research natural areas. Desired conditions promote these areas to be excellent examples of the ecological features for which they were designated, with little evidence of human activity or disturbance

(SA-RNABotGeo-DC-1). Proposed research natural areas would be managed to maintain or enhance the conditions or values for which they are proposed (SA-RNABotGeo-DC-6). Permitted uses are to be managed to protect the uniqueness and/or ecological condition of these special areas (SA-RNABotGeo-G-5). When a research natural area occurs in an active grazing allotment, allotment management plans are to have provisions to protect the uniqueness and/or ecological condition of these special areas (SA-RNABotGeo-G-4).

For the Rocky Gulch Proposed Research Natural Area, these plan components would only have a minor effect on livestock. As noted above, this area only has low intensity livestock grazing. Restricting livestock grazing from this area would have no effect on any of the currently allocated head months in the Apache Maid Allotment. As a result, research natural area management and proposals under alternative B (modified) would not result in a change in current livestock grazing because it is already low or nonexistent in these areas. Conversely, livestock grazing would have very limited impact (such as improvement maintenance or cross country motorized travel to gather/herd livestock) on these areas due to the low or nonexistent grazing intensity that is likely to occur in these areas under alternative B (modified).

Alternative C

The effects from livestock grazing, and to allotment management, would be the same under alternative C as alternative B (modified), with the exception of the recommended establishment of 13 wilderness areas (which includes the 3 recommended wilderness areas listed in alternative B (modified)) and 8 management areas that are designed to create areas with reduced human-related disturbances.

The 13 recommended wilderness areas in alternative C encompass 91,757 acres (see appendix A, map 29). Acres available for livestock grazing and permitted head months would be the same as both alternative A and alternative B (modified). Livestock grazing would continue under current livestock management until areas are designated. Most of these areas have been determined to be suitable for livestock grazing, but 2,375 acres in the Strawberry Crater, Barbershop, Hackberry, and Railroad Draw recommended wilderness areas have been determined as not suitable for livestock grazing.

Livestock grazing, maintenance of existing range structural improvements, and implementation of new improvements (pipeline and fencing) on Walker Mountain would continue under current management direction and guidelines until areas are designated. Improvements would be maintained and managed in a manner compatible with maintaining the natural character of these areas similar to that described for alternative B (modified). Motorized access and new structural improvements would be subject to the same limitations as alternative B (modified).

The limitations that could be applied if recommended wilderness areas are formally designated as wilderness are also described above in alternative B (modified). These limitations would be applied to more structural improvements over a wider area; 91,757 acres under alternative C versus 8,733 acres in alternative B (modified). Furthermore, these limitations would affect more term grazing permits, through restrictions in grazing use (such as changes in livestock numbers and season of use) or use of motorized-equipment for structural improvement maintenance.

The Abineau, Davey's, Walker Mountain, Strawberry Crater, East Clear Creek, and Barbershop recommended wilderness areas have few structural range improvements within their boundaries or structural range improvements that are located in these areas are easily accessible within associated allotments. This means that the aforementioned limitations are unlikely to affect the allotment management of these areas. Thus, maintenance would not impact wilderness character significantly. Some of these recommended wilderness areas currently have little to no grazing occurring due to topography or current permit terms and conditions.

Management of the allotment associated with the Railroad Draw recommended wilderness area would be impacted if it gets designated as wilderness. This recommended wilderness area contains a motorized dispersed camping site associated with sheep management. Use of the site in the interim between wilderness recommendation and designation would be dependent on the effects of this activity to the area's wilderness character. However, if this recommended wilderness area is designated as wilderness, motorized dispersed camping would no longer be allowed. There are other nearby motorized dispersed camping sites that could be used for sheep management. However, these sites are further away from the areas used by sheep and require additional foot or horseback travel time to achieve the same level of required permit management.

The Hackberry, Cimarron-Boulder, Tin Can, Black Mountain, and Cedar Bench recommended wilderness areas overlap other areas that have a higher density of structural range improvements than occurs under alternative B (modified). These additional structural range improvements increase the amount of maintenance that will be needed for watering facilities and fences, as compared with alternative B (modified). Maintenance for these structural range improvements would require additional analysis on the impacts (such as compaction, running over vegetation causing damage and potential loss, subsequent erosion if motorized trails are created) of any related motorized access and maintenance practices on wilderness character. This would occur with the updated environmental analysis for these allotments. In most cases, maintenance of existing structural range improvements should be allowed to continue but cross-country travel would be minimized. If the guidelines for recommended wilderness require changing grazing practices outlined in the annual operating instructions, this would be determined on a site-specific basis.

The Hackberry and Cimarron-Boulder recommended wilderness areas have the most structural range improvements under this alternative. The Hackberry recommended wilderness area has 29 watering facilities within the recommended wilderness and dozens of miles of fences. The Cimarron-Boulder recommended wilderness area has 18 watering facilities. The large number of structural range improvements within both of these recommended wilderness areas could necessitate the regular use of mechanized equipment within the recommended wilderness, and thus, would negatively impact (due possibly to noise from heavy equipment cleaning out stock tanks or digging up pipelines for repair, ATVs/UTVs carrying fencing supplies to repair long sections of fence, chain saws being used to cut trees out of fence lines or cut small pole sized trees to create fence stays) visitors wilderness experience. The Tin Can, Black Mountain, and Cedar Bench recommended wilderness areas all have several watering facilities within them that would require the same steps to ensure proper maintenance. The number and frequency of effects (as described above) is much less than for Hackberry and Cimarron-Boulder recommended wilderness areas, as they have fewer structural range improvements. The restrictions on new structural range improvements are not expected to have a measureable effect on the acres of forage that are currently available or the animal unit months permitted in these allotments. The restrictions would only qualitatively change allotment management and may prevent the expansion of new structural range improvements within recommended wilderness. If the restrictions on maintenance of existing structural range improvements results in water improvements not being maintained, it would have the corresponding effect of reducing the acres of available forage near the water improvement which would result in a reduction of animal unit months permitted in these allotments.

Alternative C would affect game and wildlife management by reducing any potential to increase number and distribution of water sources in recommended wilderness. The Arizona Game and Fish Department or U.S. Fish and Wildlife Service may want to maintain some of the waters that can be accessed by motorized vehicle in recommended wilderness. Like alternative B (modified), alternative C contains a guideline that constrains motor vehicle use to limited administrative and permitted activities to be consistent with the area's wilderness character. (SA-RWild-G-3) Under alternative C, this guideline would

apply to 91,757 acres as compared to 8,733 acres under alternative B (modified) and no acres under alternative A. As a result, wildlife may become more dependent on water sources related to grazing operations in these areas, which may also be impacted (by reduced access to water if permittee or agencies are unable to maintain them adequately) by any maintenance restrictions on these recommended wilderness areas.

As mentioned above, alternative C includes eight management areas that emphasize reduced human-related disturbance. The desired conditions of these management areas include the presence of few roads and the predominance of non-motorized recreation. See appendix F for desired conditions associated with the Anderson Mesa (a modified version of alternative B (modified)), Pine Grove, Jack's Canyon, Second Chance, Blue Ridge, Limestone Pasture, Hospital Ridge, and Knoll Lake. The guidelines associated with some of the new management areas would limit and potentially reduce public motorized access. The forest plan does not make site-specific decisions. Therefore, additional site-specific environmental analysis would be required to implement any motor vehicle closures. Motorized restrictions for the public would decrease recreation–grazing conflicts as compared to alternatives A and B (modified), because the guidelines do not apply to administrative access in these management areas. Grazing permittee motorized access to structural range improvements for maintenance and reconstruction and access for the purpose of carrying out allotment management would not be affected by this alternative. Permittees would still have the same level of motorized access for allotment management activities as they do currently.

Alternative C includes the same four existing and three proposed research natural areas that are included in alternative B (modified) as well as the same plan components discussed under alternative B (modified) with one exception. Instead of requiring allotment management plans that have provisions to protect the uniqueness and/or ecological condition of these special areas, alternative C includes a guideline that would restrict livestock grazing in all the research natural areas unless grazing supports or would not affect the area's research purpose (appendix F, SA-RNABotGeo-G-4).

As noted in the discussion under alternative A, livestock grazing is not being permitted in the four existing research natural areas and natural features limit livestock access to these areas. For the three proposed research natural areas, this guideline would only have a minor effect on livestock. As noted in the analysis in alternative B (modified), two of the proposed research natural areas have no livestock grazing and only the Rocky Gulch Proposed Research Natural Area has low intensity grazing. Restricting livestock grazing from these areas would have no effect on any of the currently allocated head months of the allotments.

The new guideline may result in the need for some additional fencing within the relevant allotments. However, canyon topography within these areas would minimize the need, as existing topographical features could be used to limit cattle access to the proposed research natural areas. Compared to the very limited impact (such as a very limited need for improvement maintenance or limited use of cross country motorized travel to gather/herd livestock) under alternative B (modified), alternative C has the potential for even less of an impact due to the restricted nature of livestock grazing, in general, in research natural areas.

Alternative D

The effects from livestock grazing and to range management would be the same under alternative D as alternative B (modified), with two exceptions. These exceptions are related to recommendations for new wilderness areas and the designation of a botanical special area.

Alternative D proposes no new designated wilderness areas that would lead to impacts on livestock operations on range allotments. Alternative D is similar to alternative A in this respect. However, alternative D is unlike alternatives B (modified) and C, as it proposes to designate only a geological area

and not a botanical area. Therefore, it would only designate the Cottonwood Basin Geological Area, and not the Cottonwood Basin Botanical and Geological Area.

Also, the difference for the Hackberry allotment would change from 524 acres in alternatives B (modified) and C to only 185 acres in alternative D. Designation of only a geological area would have the same types of effects to livestock grazing management as discussed in alternative B (modified) related to the Hackberry allotment as the designation of the combined Cottonwood Basin Botanical and Geological Area. However, due to the much smaller area included in the geological area, the effects under alternative D are expected to be proportionately smaller.

Cumulative Effects

The cumulative environmental consequences for a programmatic forest plan also consider lands managed by other entities in the area and describe the relative contribution of the forest plan decision when considering surrounding landscape with other similarly scaled planning efforts and opportunities.

The cumulative effects area for range includes the 6th-code watersheds on the Coconino NF that contain the grazing allotments (see Watersheds and Water in this section). The majority of the 4th code watersheds have 15 or more 6th code watersheds within the forest with the exception of the Havasu Creek and Tonto Creek 4th code watersheds that have very low acreage within the forest, and thus, have only one 6th code watershed each. These watersheds are the appropriate scale because the effects from grazing on the forest follow these watersheds. Cattle grazing effects on forest allotments and other allotments within these watershed areas affect vegetation by reducing plant height, canopy cover, and ground cover.

The timeframe for the analysis is 1980 to 2030. Historic mining and land use practices before this timeframe altered soil and range conditions such that some locations are in unsatisfactory condition relative to desired conditions, and the conditions are expected to persist for the life of the revised plan. These altered soil and range conditions stabilized and permitted livestock were reduced accordingly in the late 1970s and early 1980s.

The primary past actions that have affected vegetation resources and, thereby, current livestock grazing in the planning area are timber harvest, wildland fires, fire suppression, and grazing practices that have contributed to the current ecological conditions. Present and reasonably foreseeable actions affecting livestock grazing are mainly those that reduce the areas available for grazing or the level of forage production on those areas. Key examples include drought conditions, wildland fires, and special designations that restrict grazing. Alternative A does not directly address the impacts of these influences on forage available. Alternatives B (modified) and D influence these trends by somewhat increasing the number of special area designations and doing more to increase the long-term structure, composition, and function of the ERUs which, in turn, allow for a more resilient ecosystem and a better source of forage for livestock than alternative A. The increase in special area designations is not expected to alter the grazing management practices to the extent that alternative C does. Alternative C would do the most to increase special area designations that restrict grazing and vegetation treatments and, therefore, would push the trends of uncharacteristic fire that would increase the risk of type conversion and introduction of invasive plants that may not be palatable to livestock. It would also increase the overstory vegetation in ERUs such as Ponderosa Pine and Pinyon-Juniper with Grass that are trending away from desired conditions.

The main human-caused surface disturbance from past actions is that population growth in Arizona has driven rapid conversion of agricultural lands to residential development. As the economics have shifted to increase the value of property for private housing rather than agricultural uses, base properties across the three-county area have been converted to ranchettes and other low-density developments that have higher water use and are less able to support ecologically desired conditions. Conversion of base properties to

residential development also results in increased water use and could reduce water available for natural systems by increasing the amount of pumping or diversions. All alternatives do not change the economics that drive this land conversion trend, but they would sustain the current level of grazing in order to support base properties being conserved in a more open and natural condition.

Alternative C would affect game and wildlife management by reducing the potential to increase number and distribution of water sources in recommended wilderness. The Arizona Game and Fish Department or the Fish and Wildlife Service may want to maintain some of the waters that can be accessed by motorized vehicle in recommended wilderness. As a result, wildlife will become more dependent on water sources related to grazing operations in these areas.

The cumulative effects area off the forest is primarily private, State of Arizona, BLM, U.S. Army, and NPS. Livestock grazing occurs in the majority of these areas except within the many national monuments and Camp Navajo Army Base. Private lands within communities are not typically grazed by livestock except for by horses. Private lands outside of communities typically provide forage for smaller livestock operations, but can support larger livestock operators when the private land is in larger blocks. These larger private blocks of lands are typically used for winter grazing for the forest's permitted livestock. State lands are also typically used for winter grazing of the forest's permitted livestock. The BLM has both year-round grazing and winter grazing. Winter grazing is also from forest permitted livestock. There are no indications that livestock use within these areas is going to change much over the next 10 years.

Vegetative treatments, primarily burning and thinning of trees, would occur on these other lands. These types of treatments would increase forage for livestock and improve rangeland conditions in these areas.

Livestock grazing under the action alternatives would provide for continued availability of forage for domestic livestock and opportunities for ranching lifestyles consistent with the other desired conditions in the plan. Because an adaptive management strategy is used to adjust use with capacity and minimize any adverse effects, the cumulative consequences associated with continued grazing use are minimal. The expected relative significance of the implementation of the action alternatives' plan decisions within the context of the greater landscape would be a slight increase in available forage with minimal consequences to other resources and continued opportunities to graze livestock in northern Arizona.

Lands and Realty. Between 1987 and 2010, the forest increased in acreage by 34,460 acres through various land adjustment processes. It is anticipated that over the next 10 to 15 years, there would be a net increase of land acreage, although at a much smaller scale than in the previous plan's time period. Acquisition of land would occur as funding and willing sellers or cooperators are present and consistent with the desired objectives. It is anticipated that community needs and other land adjustment cases would result in conveyance of NFS land adjacent to private lands throughout the life of the plan.

Adjustments of affected livestock grazing allotments could occur if additional lands that meet the suitability/capability criteria become available. Changes to livestock grazing could include one or more of the following actions: increase in stocking levels, distribution of livestock to other areas; a longer grazing period; a change in livestock management practices (e.g., water hauling, fencing, and water development) or no changes in grazing management practices. However, it is very likely that any land adjustments would involve small acreages and would not result in a change in the number of permitted livestock or livestock management. This variable is expected to have the same results across all alternatives because the rate of conveyance of lands to the Forest Service is based on budgets and willing sellers more so than the forest plan.

Recreation. Increasing recreational demand would likely occur forestwide over the life of the plan to create new conflicts with livestock grazing. The fastest growth is anticipated in the southern portion of the

forest, where the population growth would drive recreation demand and there is an abundance of underutilized recreation opportunities. With the development of additional bike trails, equestrian trails, and/or motorized trails, there may be increased human encroachment into active grazing allotments on and around these areas. Increased interaction of livestock with the public could also result in gates being left open or fences being damaged or removed. This could result in livestock grazing at times or places other than specified in the permit or the annual operating instructions.

Since the forest started implementation of the ongoing Travel Management Rule process in 2012, areas have been reduced that allow for cross-country travel on the Coconino NF and public motorized travel has been restricted to designated roads, trails, and areas (see the Recreation and Special Areas Report). This reduction is expected to result in substantially fewer conflicts between motorized recreation and livestock grazing than prior management at the forestwide scale. All alternatives are expected to result in levels of public motorized vehicle access that are similar to or less than the post-2012 level of access on a forestwide scale, but may result in changes in the distribution of motor vehicle roads and trails across the landscape. For example, alternative C would lead to reduced public motor vehicle access in those management areas that are managed for reduced human-related disturbance. However, this direction in alternative C would not prevent increases in use in other parts of the forest per the recreation opportunity setting and resource management. As a result, under all alternatives, grazing–motorized vehicle conflicts would be reduced forestwide based on the reduction of recreational access, but may increase or decrease further depending on the distribution of uses under the alternative. Under all alternatives, permittees would continue to follow stipulations in their term grazing permit, annual operating instructions, or other permits issued by a forest official regarding cross-county motorized travel and use of administrative roads. However, future decisions, including the forest plan revision and renewal of term grazing permits, may impact the areas where administrative use of motor vehicles may occur. These decisions would be a process independent of changes to the motor vehicle use map, which only limits motor vehicle travel by the general public.

Geology and Mineral Extraction. Currently, there are low levels of mineral development within the Coconino NF. In the foreseeable future, there is potential for further development of mineral materials (gravel pits, cinders, crushed basalt, and landscape rock), but it is not expected to vary by alternative because the demand is low enough that it is unlikely to exhaust available resources under any alternative. Therefore, restrictions of related activities would not affect the occurrence of mineral extraction on the forest. Extraction of mineral materials could impact livestock grazing by removing vegetation, limiting access on some roads, causing gate issues on existing fences, increasing vehicle traffic, and modifying grazing management on an allotment. Reclamation would restore vegetation in most cases when mineral operations conclude, but there could be some irretrievable loss of rangeland vegetation or a change in vegetation communities. Site-specific analysis and best management practices would provide further mitigation and protection of range sites.

Invasive Weed Management. The spread of invasive weeds into grazing allotments could result in the temporary closure of affected grazing lands to expedite treatment and eradication measures, and to reduce the potential risk of livestock spreading invasive weeds. Increased abundance of invasive weeds would reduce the quality of native plant habitat by displacing native species, altering nutrient and fire cycles, degrading soil structure, and decreasing the quality and availability of forage for livestock and wildlife (Chapin et al. 2000). In some situations, domestic livestock may be used to reduce invasive weed infestations and their impacts.

Socioeconomic Analysis

The study area offers a diverse mix of people, locations, activities, and attractions that contribute to the social and economic context around the Coconino NF. The Coconino NF extends into three counties—Coconino, Gila, and Yavapai (figure 8). However, less than one-third of 1 percent of the Coconino NF is in Gila County. As a result, Gila County would not be included in the social and economic analysis study area. In addition, Maricopa County would be included in the study area due to the social and economic linkages between residents of Maricopa County (particularly the Phoenix metropolitan area) and the Coconino NF. A number of day-use recreation visits originate in Maricopa County and firms in the county process materials from the Coconino NF (e.g., timber and minerals). The size of Maricopa County could easily dominate the data. Therefore, to the extent practicable, social and economy data would be presented in a disaggregated (county-level) form.

The study area includes all or part of tribal lands and reservations belonging to the following American Indian tribes: Navajo Nation, Hopi Tribe, Hualapai Tribe, Havasupai Tribe, Kaibab-Paiute Tribe, Yavapai-Prescott Tribe, Yavapai-Apache Nation Tribe, Fort McDowell Yavapai Nation, Salt River Pima-Maricopa Indian Community, Gila River Indian Community, and Tohono O'odham Nation.

Flagstaff, surrounded by vast ponderosa pine forests of the Coconino NF and nearby Kaibab National Forest and windswept mesas of the Navajo and Hopi Reservations, is the largest city in northern Arizona, and serves as a governmental, educational, cultural, recreational, and commercial center of activity in northern Arizona. Several national monuments, a historic downtown, the Lowell Observatory, the Museum of Northern Arizona, and Riordan State Park offer various activities and learning opportunities. Northern Arizona University and Coconino Community College are both located in Flagstaff and provide educational opportunities for students of all ages. Due to its high elevation, the city offers a markedly cooler climate than other cities in the state, in part accounting for the high rate of second homes in Flagstaff.

The internationally known Grand Canyon National Park is within the study area and brings significant numbers of tourists directly through the Coconino NF as they travel to and from the Grand Canyon and surrounding attractions. Sedona, which lies within the Red Rock Ranger District of the Coconino NF, provides warmer climates and strikingly different scenery, with its famous red rock country and Oak Creek Canyon. Cultural, commercial, and recreational opportunities abound in this southwestern region of the Coconino NF.

Phoenix, the capital of Arizona, is the most populous city in the State and the sixth most populous in the Nation. The climate is hot and arid, with extreme temperatures in the summer and milder temperatures in the winter season. As the hub of the rapidly growing southwest region, Phoenix is a governmental, commercial, industrial, technological, and cultural center and offers all of the amenities common to a city of its size. The Coconino NF and other parts of northern Arizona provide cool summer retreats within a 2-hour drive from Phoenix (figure 8).

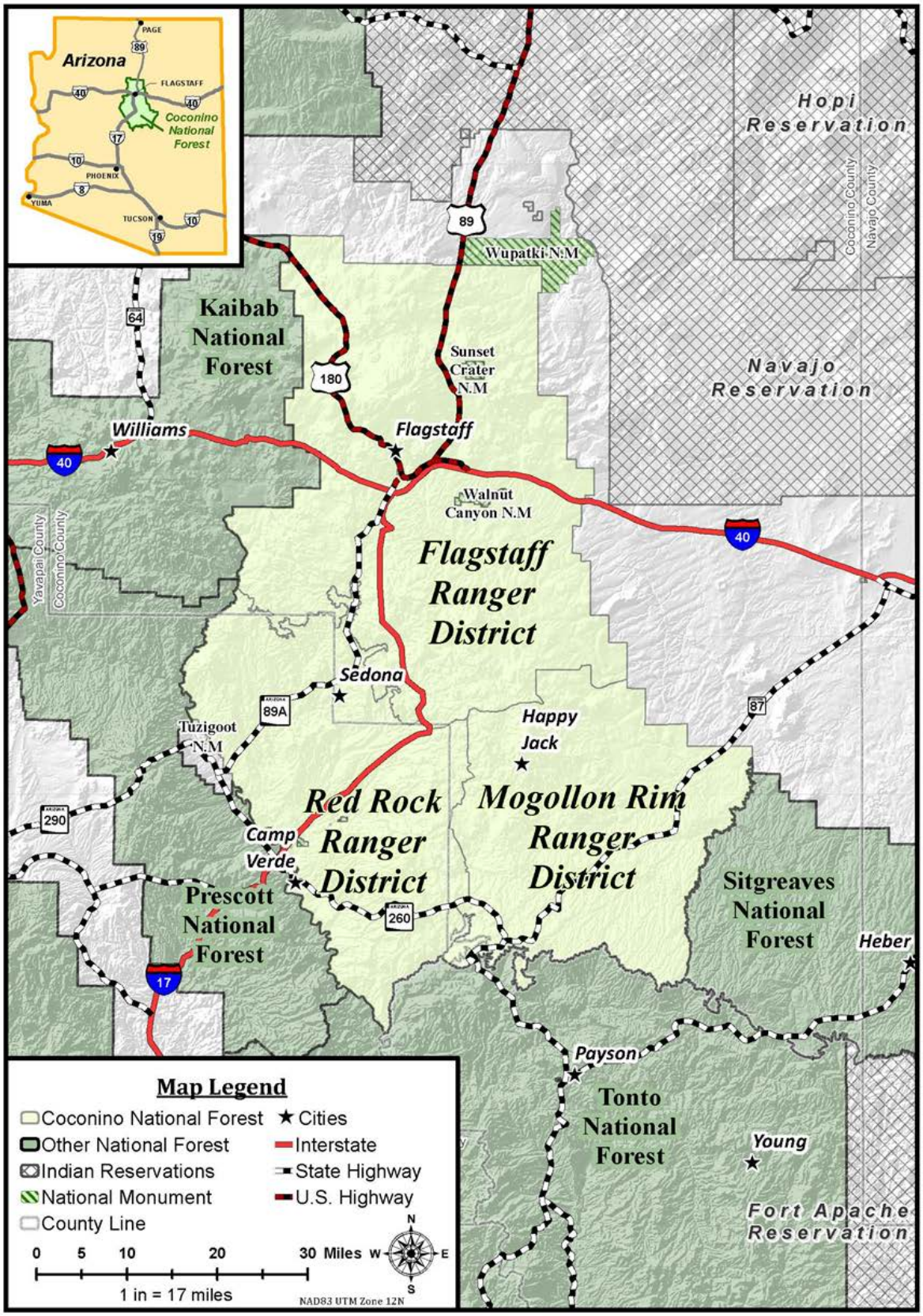


Figure 8. Vicinity map of the Coconino National Forest

Affected Environment

Existing social and economic conditions are necessary to establish the baseline from which to estimate potential consequences of forest management actions. The following section analyzes the current conditions and trends related to the social and economic environment of the planning area, including: population and demographic changes, potential environmental justice populations, and local economic conditions.

Population and Demographics

This section highlights population and demographic trends in the study area. Population is an important consideration in managing natural resources. In particular, population structure (size, composition, density, etc.) and population dynamics (how the structure changes over time) are essential to describing the consequences of forest management and planning on a social environment (Seesholtz et al. 2004). Population increases may lead to conflicts over land use, travel management, recreation activities, and values. These are conflicts that Forest Service managers attempt to balance when making management decisions.

Population Growth

The study area is home to 4,162,571 people (U.S. Census Bureau 2010). Table 72 displays population data for the counties, State, and Nation in 1990, 2000, and 2010.

Table 72. Population change: 1990 to 2000 and 2000 to 2010

Area	1990	2000	Growth, 1990–2000	2010	Growth, 2000–2010
Coconino County	96,591	116,320	20.4%	134,421	15.6%
Maricopa County	2,122,101	3,072,149	44.8%	3,817,117	24.2%
Yavapai County	107,714	167,517	55.5%	211,033	26.0%
Study Area Total	2,326,406	3,355,986	44.3%	4,162,571	24.0%
Arizona	3,665,228	5,130,632	40.0%	6,392,017	24.6%
United States	248,709,873	281,421,906	13.2%	308,745,538	9.7%

Source: U.S. Census Bureau, 1990, 2000, and 2010

Maricopa County is by far the largest county in the study area, and it alone accounts for approximately 60 percent of Arizona's population. As a result, the study area totals are dominated by Maricopa County. These data highlight the importance of presenting socioeconomic information at a county level; otherwise, the inclusion of Maricopa County could mask substantial changes in other counties.

The study area population growth rate mirrored Arizona's population growth rate between 1990 and 2010. However, the growth rates during this time varied among study area counties. The population in Maricopa and Yavapai Counties grew at approximately double the rate of Coconino County. Regardless, all study area counties surpassed the national population growth rate in 1990 to 2000 and 2000 to 2010.

Rapid population growth may signal expanding economic opportunities and/or desirable amenities. Much of Coconino, Maricopa, and Yavapai Counties are occupied by protected Federal lands. National Forest System and Bureau of Land Management lands provide natural amenities and employment opportunities for area residents.

Population Density

Population density can serve as an indicator of a number of socioeconomic factors of interest—urbanization, availability of open space, socioeconomic diversity, and civic infrastructure (Horne and Hayes 1999). More densely populated areas are generally more urban, diverse, and offer better access to infrastructure. In contrast, less densely populated areas provide more open space, which may offer natural amenity values to residents and visitors. Table 73 displays the number of people per square mile for each of the counties of interest.

Table 73. Population density

Area	People per Square Mile
Coconino County	7.2
Maricopa County	414.8
Yavapai County	26.0
Arizona	56.3
United States	86.6

Source: U.S. Census Bureau 2010

Despite substantial gains in population since 1990, both Coconino and Yavapai Counties continue to have relatively low population density, in part because of the large areas of National Forest System, Department of the Interior, and tribal lands. Both counties are less dense than the State and Nation. In contrast, Maricopa County is much denser than the State and Nation, with more than 400 people per square mile in the county.

These findings suggest that the study area, outside of the Phoenix metropolitan area, is quite rural. However, the population is not evenly distributed within counties. Much of the population in Coconino and Yavapai Counties is concentrated in more urban areas—the Flagstaff metropolitan area in Coconino County and the Prescott metropolitan area in Yavapai County.

Low population density also points to large amounts of public lands, including Forest Service, Bureau of Land Management, and State lands or Indian reservation land (Arizona Department of Commerce 2008). In all of the Arizona counties included in the analysis, a minority of the land is privately owned. Maricopa County has the highest private ownership rate, at 29 percent, with Yavapai County and Coconino County rates of approximately 25 percent and 13 percent private landownership, respectively. High public landownership may correspond with increased reliance on public lands for economic well-being and social/cultural experiences. The abundance of public lands can also lead to the sentiment that national forests and other public lands form area residents' "back yard." As a result, residents of counties with large proportions of public lands are likely to be more acutely affected by land management decisions.

Age and Gender

Age data may be relevant for forest management decisions. A population's age may affect community values and uses associated with NFS lands. For example, older populations are more likely to desire easily accessible recreation opportunities. Younger populations are generally more able to participate in extreme recreation opportunities, like downhill mountain biking or canyoneering, and may demand those types of activities on the forest.

Table 74 lists the median age by county for the study area. As with other population characteristics, the median age varies substantially between counties. Coconino County is markedly younger than the

national median age, likely due to the relatively high population of students at Northern Arizona University and Coconino Community College. Maricopa County is relatively young with median ages below the state and national medians. In contrast, Yavapai County exceeds the state and national median ages by nearly a decade. A high median age generally indicates that a relatively large number of retirees reside in the area. An area with a large percentage of retirees would earn income primarily from investments and transfer payments (such as dividends and Social Security), rather than salaries and wages.[49]

Table 74. Median age

Area	Median age
Coconino County	31.8
Maricopa County	33.3
Yavapai County	44.5
Arizona	35.1
United States	36.8

Table 75 displays the gender breakdown for the study area counties, the State, and the Nation. None of the counties markedly deviate from State and national conditions in terms of gender distribution; therefore, the study area isn't greatly impacted by issues typically associated with gender disparities (such as gender-dominated industries or a high number of single-parent households). Even though there is a high retiree population in Yavapai County, table 75 indicates that population is not affecting gender distribution.

Table 75. Gender distribution

Area	Females (Percent of Total Population)	Males (Percent of Total Population)
Coconino County	50.1	49.9
Maricopa County	49.6	50.4
Yavapai County	50.9	49.1
Arizona	49.9	50.1
United States	50.7	49.3

Source: U.S. Census Bureau 2008

Educational Attainment

Educational attainment, the measure of people with at least a high school diploma or bachelor's degree, is an important indicator of an area's social and economic opportunities and its ability to adapt to change. Table 76 lists the percentage of the adult population with at least a high school diploma and a bachelor's degree.

[49] This prediction is reflected in the nonlabor income data presented in Table 81. More than 50 percent of the income in Yavapai County comes from nonlabor sources.

Table 76. Educational attainment, percentage of adults age 25 and over

Area	High School Graduate	Bachelor's Degree or Higher
Coconino County	86.1%	30.1%
Maricopa County	84.3%	27.5%
Yavapai County	88.7%	23.9%
Arizona	83.9%	25.7%
United States	84.6%	27.5%

Source: U.S. Census Bureau 2009

The vast majority of adult residents in the study area are high school graduates, surpassing the State percentage, and in all but one county, exceeding the national percentage. Approximately a quarter of study area residents have a bachelor's degree or higher, which is similar to the State and national percentages, with the exception of Coconino County, which well exceeds both the State and national rates. These findings suggest that the overall study area is relatively well educated when compared to adjacent counties within the State,[50] and opportunities likely exist for working-age adults with high levels of education.

The presence of highly educated adults may be self-reinforcing: a highly educated population is a signal that an area provides economic and cultural opportunities, which attracts additional college educated adults to the area. This process leads to further economic development and job creation. In contrast, areas with low levels of educational attainment have lower levels of human capital, which reduces an area's ability to capitalize on economic change (Florida 2002).

There are a number of institutions of higher education in the study area, including Arizona State University and Northern Arizona University. Post-secondary institutions improve a county's ability to at least temporarily retain and attract young residents. However, a high incidence of educational institutions may result in the number of highly educated young individuals exceeding the number of available jobs in the study area. As a result, after completing their education, some young people may migrate out of the area to seek jobs commensurate with their education levels.

The presence of educational institutions in the study area may be relevant for forest management decisions. Affiliated research institutions, professors, and students may choose to propose research or implement coursework or projects on NFS lands, requiring a special use permit or other specialized interaction with the forest. Advanced education correlates with higher earnings. Higher incomes enable increased participation in recreation and other leisure pursuits on the forest. As a result, areas with highly educated populations are likely to have a higher demand for diverse and plentiful public land recreation opportunities.

Forest Visitors

Table 77 reports Coconino NF activity participation. Viewing natural features, hiking/walking, viewing wildlife, relaxing, and driving for pleasure are activities in which more than half of Coconino NF visitors engage. Hiking/walking is the most common main activity (the primary purpose of the forest visit), followed by viewing natural features, relaxing, and driving for pleasure.

[50] Adjacent counties' percentage of adults age 25 and over with a bachelor's degree or higher in 2005 through 2009: Navajo Co. - 13.3 percent; Graham Co. 13.5 percent; Pinal Co. 18 percent; Pima Co. 29 percent; Yuma Co. 13 percent; La Paz Co. 9.9 percent; Mohave Co. 12.1 percent (U.S. Census Bureau State and County Quick Facts website: http://quickfacts.census.gov/qfd/states/04/04015.html).

These findings suggest that Coconino NF visitors engage in a diverse range of activities, including both motorized and non-motorized uses in developed and undeveloped areas.

Table 77. Forest activity participation

Activity	Percent Participate in Activity	Percent Participate as Main Activity	Number Participate as Main Activity	Average Hours Participation
Developed Camping	5.5	1.8	51,624	20.5
Primitive Camping	4.2	0.8	22,944	16.3
Backpacking	1.4	0.4	11,472	30.7
Resort Use	2.7	0.0	0	14.5
Picnicking	21.4	1.3	37,284	6.9
Viewing Natural Features	73.1	23.7	679,716	2.4
Visiting Historic Sites	29.2	3.2	91,776	1.8
Nature Center Activities	26.4	0.4	11,472	1.6
Nature Study	17.0	0.4	11,472	2.4
Relaxing	62.3	7.1	203,628	6.5
Fishing	4.8	1.9	54,492	5.3
Hunting	2.1	1.7	48,756	31.9
OHV Use	9.0	0.7	20,076	3.8
Driving for Pleasure	46.1	3.5	100,380	2.9
Snowmobiling	0.0	0.0	0	0.0
Motorized Water Activities	1.0	0.3	8,604	3.3
Other Motorized Activity	0.5	0.0	0	0.0
Hiking/Walking	70.8	32.0	917,760	3.0
Horseback Riding	1.2	0.1	2,868	1.5
Bicycling	6.2	3.0	86,040	2.3
Non-motorized Water	1.8	1.2	34,416	6.3
Downhill Skiing	5.0	4.5	129,060	4.0
Cross-country Skiing	1.2	0.9	25,812	3.1
Other Non-motorized	13.0	4.7	134,796	2.8
Gathering Forest Products	3.3	0.5	14,340	4.4
Viewing Wildlife	48.7	2.4	68,832	2.1
Motorized Trail Activity	3.8	0.5	14,340	3.2
Some Other Activity	4.3	3.6	103,248	2.0
No Activity Reported	0.7	0.7	20,076	N/A

Source: USDA Forest Service 2016b (NVUM 2010)

Environmental Justice

In 1994, President Clinton issued Executive Order (EO) 12898. This order directs Federal agencies to focus attention on the human health and environmental conditions in minority and low-income communities.[51] The purpose of EO 12898 is to identify and address, as appropriate, disproportionately high and adverse human health or environmental effects on minority and low-income populations.

[51] According to USDA DR5600-002 (USDA 1997), environmental justice, minority, minority population, low-income, and human health and environmental effects, are defined as follows:
Environmental justice means that, to the greatest extent practicable and permitted by law, all populations are provided the opportunity to comment before decisions are rendered on, are allowed to share in the benefits of, are not excluded from, and are

Environmental justice is the fair treatment and meaningful involvement of people of all races, cultures, and incomes, with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies. The goal of environmental justice is for Federal agency decision makers to identify impacts that are disproportionately high and adverse with respect to minority and low-income populations and identify alternatives that would avoid or mitigate those impacts.

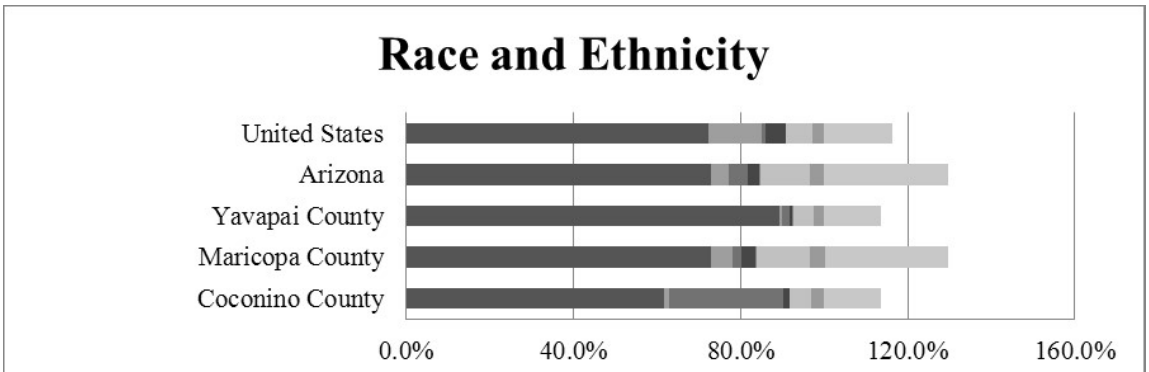
The emphasis of environmental justice is on health effects and/or the benefits of a healthy environment. The Council on Environmental Quality (CEQ) has interpreted health effects with a broad definition: "Such effects may include ecological, cultural, human health, economic or social impacts on minority communities, low-income communities or Indian Tribes…when those impacts are interrelated to impacts on the natural or physical environment" (CEQ 1997).

According to the U.S. Census Bureau (2010) data, study area counties differ substantially in their racial and ethnic composition (see figure 9).

Coconino County has a high concentration of American Indian residents, because of the five reservations in the county.[52] Maricopa County has the highest proportion of Hispanic/Latino residents in the study area, although it is equivalent to Arizona's proportion (29.6 percent). In contrast, Yavapai County is less diverse than both the state and nation. Approximately 90 percent of Yavapai County residents are white. As a result, environmental justice issues are more likely to occur in Coconino and Maricopa Counties than Yavapai County. However, a finding of low racial/ethnic diversity does not eliminate the need to consider potential disproportionate impacts of Forest Service management actions. A county may have a low overall concentration of minority residents, but still have areas with a high concentration of minority residents that could be adversely affected by management actions.

not affected in a disproportionately high and adverse manner by, government programs and activities affecting human health or the environment.
Minority means a person who is a member of the following population groups: American Indian or Alaskan Native; Asian or Pacific Islander; Black, not of Hispanic origin; or Hispanic.
Minority population means any readily identifiable group of minority persons who live in geographic proximity to, and, if circumstances warrant, migrant farm workers and other geographically dispersed/transient persons who will be similarly affected by USDA programs or activities.
Low-income population means any readily identifiable group of low-income persons who live in geographic proximity to, and, if circumstances warrant, migrant farm workers and other geographically dispersed/transient persons who will be similarly affected by USDA programs or activities. Low-income populations may be identified using data collected, maintained and analyzed by an agency or from analytical tools such as the annual statistical poverty thresholds from the Bureau of the Census' Current Population Reports, Series P-60 on Income and Poverty.
Human health and/or environmental effects as used in this Departmental Regulation includes interrelated social and economic effects.

[52] Coconino County contains all or part of the Navajo Nation Indian Reservation, Hualapai Indian Reservation, Hopi Indian Reservation, Havasupai Indian Reservation, and Kaibab Paiute Indian Reservation.



	Coconino County	Maricopa County	Yavapai County	Arizona	United States
White	61.7%	73.0%	89.3%	73.0%	72.4%
Black or African American	1.2%	5.0%	0.6%	4.1%	12.6%
American Indian and Alaska Native	27.3%	2.1%	1.7%	4.6%	0.9%
Asian	1.4%	3.5%	0.8%	2.8%	4.8%
Native Hawaiian and Other Pacific Islander	0.1%	0.2%	0.1%	0.2%	0.2%
Some Other Race	5.2%	12.8%	4.9%	11.9%	6.2%
Two or More Races	3.1%	3.5%	2.5%	3.4%	2.9%
Hispanic or Latino (of any race)	13.5%	29.6%	13.6%	29.6%	16.3%

Source: U.S. Census Bureau 2010

Figure 9. Race and ethnicity

Table 78 reports the percentage of residents living in poverty. Maricopa and Yavapai Counties have low poverty rates relative to the State. Coconino County has the highest poverty rate in the study area, above both the state and national rates.

Table 78. Percentage of residents living in poverty

Area	Poverty Rate (Percent)
Coconino County	17.4
Maricopa County	13.4
Yavapai County	12.7
Arizona	14.7
United States	13.5

Source: U.S. Census Bureau 2009

The incidence of poverty in Coconino County is not evenly distributed among racial and ethnic groups. Approximately 50 percent of American Indian residents in Coconino County live in poverty (U.S. Census Bureau 2000). The high proportion of American Indian residents in the county, therefore, increases the poverty rate relative to other study area counties and the state.

Based on the minority status and poverty data presented above, Coconino County appears most at risk for environmental justice issues. The largest minority group in the county—American Indians—also

experience a very high poverty rate. These findings raise the likelihood of observing disproportionate adverse effects to low income and/or minority residents in Coconino County. Because Coconino County contains the most acreage of the Coconino NF (over 1.4 million acres), the consequences of management actions on the forest could be felt most acutely by the low income and/or minority residents of Coconino County. The effects of the alternatives as they related to environmental justice are included below in the Environmental Consequences section.

Employment and Income

The previous section assessed demographic trends in the study area relative to state and national averages. This section focuses on economic conditions and trends. This discussion provides additional information on the social and economic environment in the study area.

Per Capita Income

Per capita income is a key indicator of the economic well-being of a county. High per capita income may signal greater job opportunities, highly skilled residents, greater economic resiliency, and well-developed infrastructure. Table 79 provides data on per capita income in 2009 for the counties, State, and Nation.

Table 79. Per capita income, 2009 U.S. dollars

Area	Per Capita Income
Coconino County	$22,238
Maricopa County	$27,185
Yavapai County	$25,458
Arizona	$25,203
United States	$27,041

Source: U.S. Census Bureau 2009

Per capita income in the study area is similar to per capita income in the state and Nation. Coconino County has the lowest per capita income among the study area counties, which is consistent with the finding in the Environmental Justice section that Coconino County has a relatively high poverty rate.

Median Earnings

Per capita income offers an incomplete picture of the economic well-being of an area. Table 80 presents data on median earnings for workers. Whereas per capita income considers all sources of income (including wage and salary payments, transfer payments, investment earnings, dividends, and rents), and median earnings considers only wage and salary earnings.

Median earnings in Coconino and Yavapai Counties are below state and national medians. Maricopa County has slightly higher median earnings than either the State or Nation, indicating that Maricopa County offers relatively high-paying employment.

Table 80. Median earnings for workers, 2009 U.S. dollars

Area	Median Earnings
Coconino County	$23,391
Maricopa County	$31,011
Yavapai County	$24,372
Arizona	$28,748
United States	$29,050

Source: U.S. Census Bureau 2009

Median earnings are higher than per capita income in Coconino and Maricopa Counties, which suggests that employed residents of these counties have slightly higher incomes than individuals who do not derive income from employment (e.g., retirees). In contrast, median earnings are lower than per capita income in Yavapai County, which suggests that retirees have higher incomes than workers in the county.

Nonlabor Income

Table 81 displays the role of labor and nonlabor income in total personal income for 2000 and 2009. Nonlabor income is any income derived from investments, dividends, rents, or transfer payments. In contrast, labor income is salary and wage disbursements from employment. During the past decade, the percentage of total income derived from nonlabor sources increased in all considered areas.

Nonlabor income is not directly tied to employment; therefore, it can be more resistant to economic downturns. However, as the most recent recession demonstrated, asset markets can be quite volatile, and nonlabor income that depends on investment returns may be unstable.

An increase in nonlabor income may reflect changing demographic characteristics. Older populations rely largely on nonlabor income, including rents, dividends, and transfer payments (such as Social Security). High percentages of nonlabor income likely indicate higher concentrations of retirees.

Table 81. Contribution of labor and non-labor income to total personal income, 2000 and 2009

Area	2000 Labor Percent	2000 Nonlabor Percent	2009 Labor Percent	2009 Nonlabor Percent
Coconino County	64%	36%	62%	38%
Maricopa County	72%	28%	66%	34%
Yavapai County	50%	50%	43%	57%
Arizona	68%	32%	62%	38%
United States	69%	31%	64%	36%

Source: U.S. Bureau of Economic Analysis 2011a

Nonlabor income dominates total personal income in Yavapai County, where it accounts for more than half of income. This finding is consistent with the median age data presented in table 74, which showed that the median age in Yavapai County is approximately a decade older than the state and national medians.

The distribution of labor and nonlabor income in Coconino and Maricopa Counties mimics the State and national distributions.

Unemployment

The unemployment rate provides insight into the correspondence between residents' skills and employment opportunities. The "natural" rate of unemployment is said to be around 5 percent. This is the so-called natural rate because this is a level that allows for movement between jobs and industries, but does not signal broad economic distress. Table 82 provides the annual unemployment rates for the counties, State, and Nation from 2001 through 2010.

Table 82. Annual unemployment rate, 2001 through 2010

Area	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Coconino County	4.7%	5.4%	5.7%	5.3%	4.9%	4.3%	3.7%	5.3%	8.3%	8.9%
Maricopa County	4.1%	5.6%	5.2%	4.4%	4.0%	3.5%	3.2%	5.1%	8.9%	9.1%
Yavapai County	4.4%	5.4%	5.1%	4.6%	4.4%	3.9%	3.6%	5.9%	10.2%	10.5%
Arizona	4.7%	6.0%	5.7%	5.0%	4.7%	4.1%	3.8%	5.9%	9.7%	10.0%
United States	4.7%	5.8%	6.0%	5.5%	5.1%	4.6%	4.6%	5.8%	9.3%	9.6%

Source: U.S. Bureau of Labor Statistics 2011b

Unemployment trends in the study area counties have mirrored state and national rates. This suggests that employment conditions in the study area are similar to broader State and national trends.

Housing

The above comparisons of per capita income and median earnings between the study area, State, and the Nation are incomplete. Data on local cost of living offer additional context. Of the contributions to cost of living, housing costs are among the most substantial. Table 83 presents median home values in 2009.

Table 83. Median value of owner-occupied homes, 2009 U.S. Dollars

Area	Median Home Value
Coconino County	$254,700
Maricopa County	$243,300
Yavapai County	$232,700
Arizona	$218,400
United States	$185,400

Source: U.S. Census Bureau 2009

All study area counties have higher median home values than the State and Nation. However, as table 79 and table 81 show, the study area counties do not have higher earnings or income than the State or Nation. Therefore, it is reasonable to suspect that study area residents spend a relatively high proportion of their income on housing expenses.

These data also imply that the study area is a desirable place to live. The natural amenities provided by the Coconino NF contribute to the attractiveness of the study area to new and existing residents.

Economic Diversity

Economic diversity generally promotes stability and offers greater employment opportunities. Highly specialized economies (those that depend on very few industries for the bulk of employment and income)

are prone to cyclical fluctuations and tend to offer more limited job opportunities. Determining the degree of specialization in an economy is important for decision makers, particularly when the dominant industry can be affected by changes in policy. For Forest Service decision makers, this is likely to be the case where the forest products industry or the tourism and recreation industries, for instance, are reliant on the local forest(s).

Figure 10 provides a breakdown of employment by industry in the study area. The study area economy is quite diverse, with no single sector dominating the local economy. This economic diversity is largely attributable to Maricopa County, which is the geographic and commercial center of the State. Government, health and social services, and the retail trade sectors are the largest employment sectors in the local economy and are consistent with findings discussed in the "Demographic" section—namely a substantial government presence due to public land management, a large retiree population that consumes health and social services, and amenities that attract tourists who contribute to the retail trade sector.

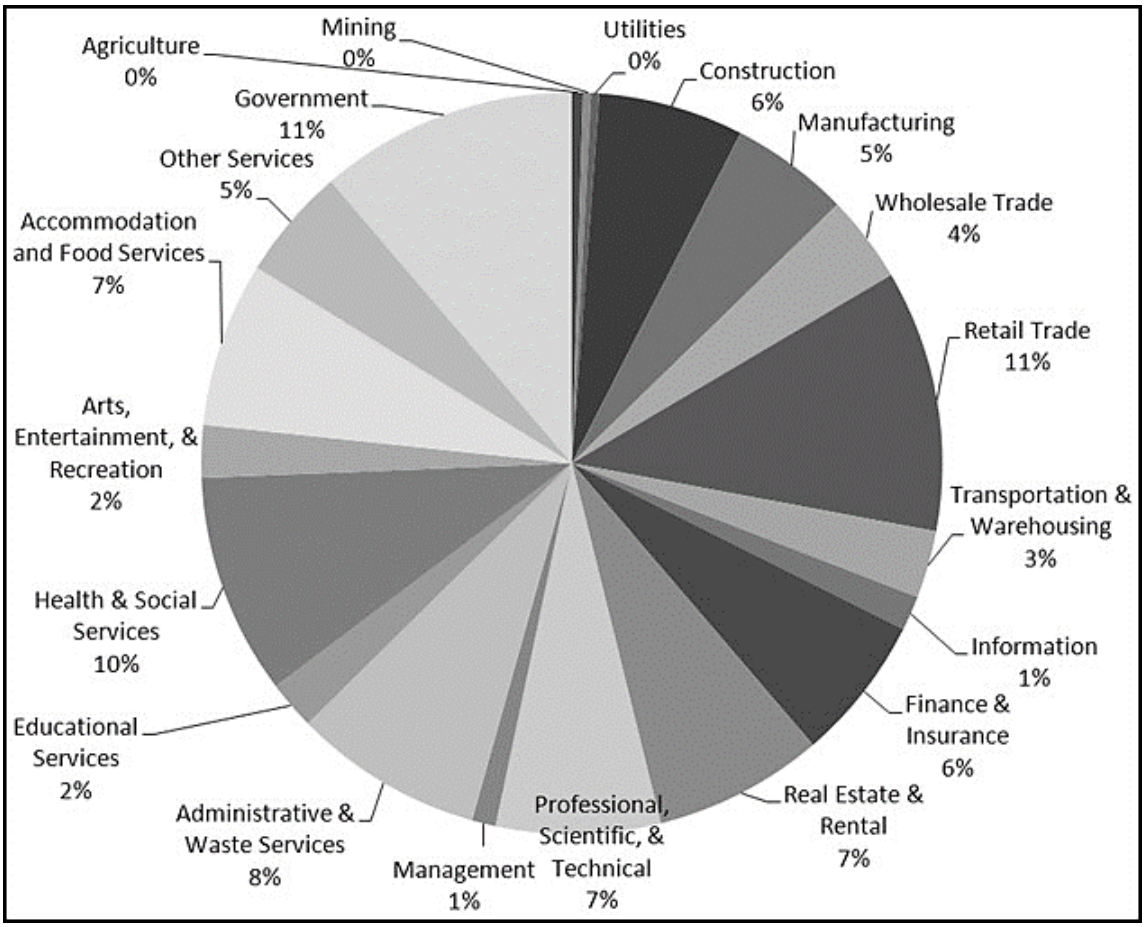


Figure 10. Employment by industry in the study area

For context, figure 11 provides a breakdown of employment by industry in Arizona. The statewide breakdown is largely similar to the study area distribution of employment, due to the dominance of Maricopa County in both the study area and state statistics.

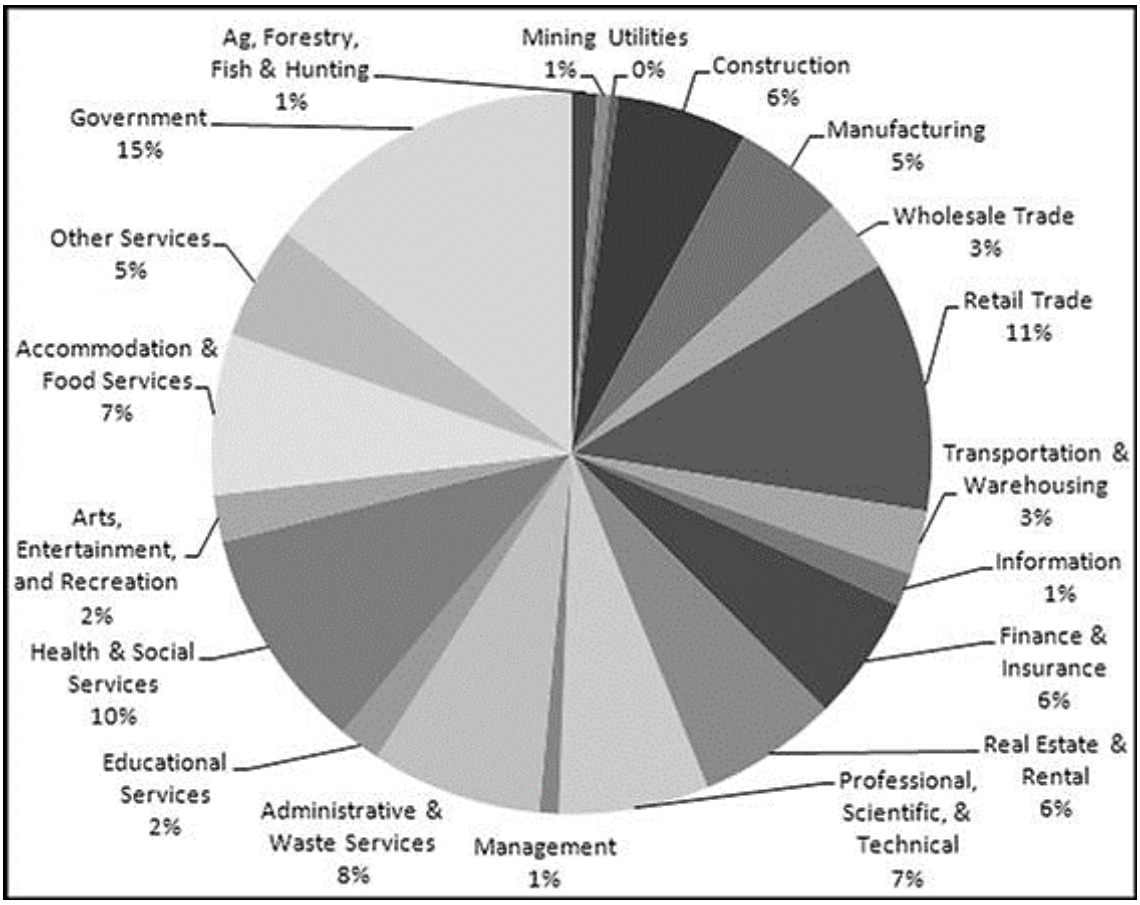
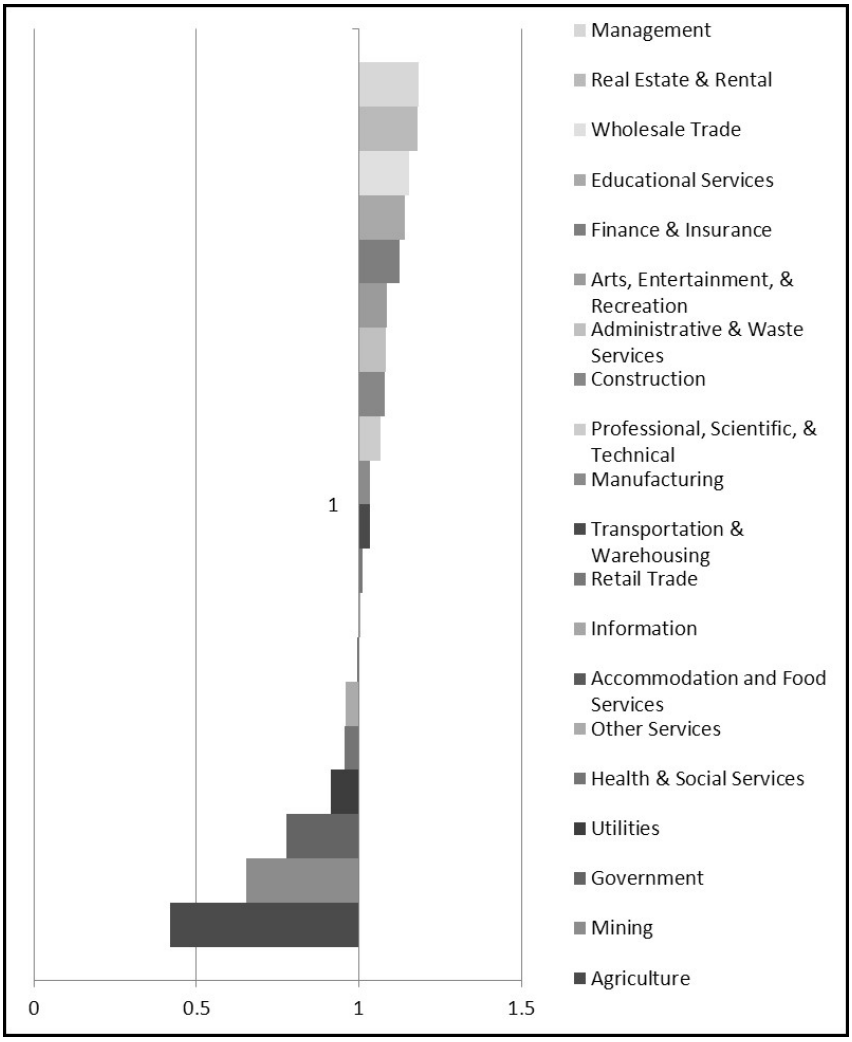


Figure 11. Employment by industry in Arizona

To identify the study area's employment specialization, or industry sectors with higher rates of employment, a methodology was used that compared the ratio of the percent employment in each industry in the study area to an average percent of employment in that industry for the State of Arizona. For a given industry, when the percent employment in the analysis region is greater than in the reference area, local employment specialization exists in that industry (USDA Forest Service 1998). In other words, a particular industry makes up a larger proportion of the local employment than it does in the State. Using this criterion applied with 2009 data, the study area can be characterized as specialized with respect to several industries, particularly management, real estate and rental, wholesale trade, and educational services (MIG 2009). Figure 12 provides the employment specialization index for all industries in the study area.

Whereas figure 10 and figure 11 consider the study area and state in isolation, figure 12 compares industry concentration in the study area to industry concentration in the state. The numbers on the x-axis of figure 12 show the degree of specialization in the local economy. These numbers are ratios of study area employment concentration relative to statewide employment concentration by industry. A score of 1 indicates that the study area and the state are equally specialized in the sector. A score greater than 1 indicates that the study area is more specialized in the sector than the state. A score less than 1 indicates that the study area is less specialized in the sector than the state. For instance, a score of 0.8 indicates that the study area is 80 percent as specialized in the sector as the State. As figure 10, figure 11, and figure 12 demonstrate, these two methods of data analysis can illustrate quite different results. While the management sector provides only 1 percent of employment by industry (figure 10) within the study area, its contribution is proportionally greater to the study area than the management sector's contribution to

the state as a whole. Among specialized sectors in the study area, the educational services, arts, entertainment, and recreation, and professional, scientific, and technical services sectors particularly benefit from activities on the Coconino NF. Local and nonlocal visitors to the Coconino NF conduct transactions in the arts, entertainment, and recreation sector; special research areas on the Coconino NF contribute to employment in the educational services sector; and astronomical facilities on the Coconino NF support activities in the professional, scientific, and technical sector.



Source: MIG 2009

Figure 12. Sectors with relatively higher rates of employment in study area

Public lands (national forests, national parks, Bureau of Land Management managed public lands, and State-owned lands), military installations, and tribal lands are common across the State and contribute to a relatively large government presence in Arizona. While government employment accounts for a relatively large percentage of total employment in the study area (figure 10), the study area is less specialized in government employment than the state. This may be a result of the fact that the study area is primarily composed of public lands managed by land management agencies, which typically employ fewer employees per location than the military bases, installations, and border patrol posts found in other parts of Arizona. Additionally, land management agencies contract with concessionaires to manage the daily operations at many parks and campgrounds, further reducing the number of people employed directly by the U.S. Government.

Payments to States and Counties

The Forest Service makes payments to states and counties that contain NFS lands. These payments fall into two categories: Payments in Lieu of Taxes and Secure Rural Schools and Community Self-Determination Act payments.

Federal agencies do not pay property taxes; therefore, Payments in Lieu of Taxes are distributed to counties to compensate for the local services that support activities on Federal lands. These services include law enforcement, road maintenance, and fire departments.

Secure Rural Schools and Community Self-Determination Act payments are intended to improve public schools, maintain infrastructure, improve the health of watersheds and ecosystems, protect communities, and strengthen local economies.

Table 84 lists the Payments in Lieu of Taxes and Secure Rural Schools and Community Self-Determination Act payments from the Coconino NF.

Table 84. Payments to the State and counties from the Coconino NF

Area	Secure Rural Schools and Community Self-Determination Act (FY 2009)	Payments in Lieu of Taxes (FY 2010)	Total Forest Service Payments
Coconino County	$1,947,584	$468,909	$2,416,493
Gila County[1]	$7,246	$10,618	$17,864
Yavapai County	$638,513	$142,113	$780,625
Coconino NF	$2,593,343	$621,639	$3,214,982

Source: USDA Forest Service 2010b and USDI 2010

[1] As the purpose of this legislation is to offset the loss in tax revenue experienced when Federal lands are included in a county, Gila County is included here to reflect total payments from the Coconino NF; however, that county remains excluded from the impact analysis. Maricopa County is not included in this table because the Coconino NF does not lie within its boundaries.

Nonmarket Values

Public lands have both market and nonmarket values. Nonmarket goods and services, such as clean air and scenic vistas, have real economic value, however, a monetary value can be difficult to accurately determine. As a result, it is difficult to analyze potential tradeoffs between market and nonmarket values.

Insufficient data and resources are available to assign monetary values to these resources. Consistent with direction provided in 40 CFR 1502.23 and Forest Service Handbook 1909.15 (7/06/04) and 22.35 (01/14/05), the subsequent analysis of environmental consequences considers nonmarket goods and services primarily in qualitative terms. Where appropriate, discussion of how the alternatives may affect nonmarket values will be presented. However, due to the qualitative nature of these discussions, direct comparisons between changes in market and nonmarket values are not possible.

Environmental Consequences

The following section considers the potential consequences of alternative management scenarios on the social and economic environment. The Methodology and Analysis—Socioeconomic Analysis section (appendix C) includes a description of the economic impact financial efficiency and social analysis procedures used in this analysis.

Economic Impact Analysis

Economic impact analysis estimates the employment and labor income consequences of forest management actions. Table 85 provides employment estimates, by alternative. Table 86 provides labor income estimates by alternative. These tables will be referenced in the alternative-specific descriptions of economic impacts.

Forest management accounts for approximately 0.20 percent of all employment in the study area. Therefore, any changes in employment among alternatives would be low-impact in the broader economic context. However, this number appears quite low due to the inclusion of Maricopa County, which contains approximately 60 percent of Arizona's population. Changes in forest-related employment may be felt more acutely in Coconino and Yavapai Counties.

The study area counties have been aggregated for the economic impact analysis due to the importance of capturing trade flows between counties. A county-by-county analysis would exclude the employment and income created in Maricopa County by activities in Coconino County, for instance. The regional economic impact analysis provides a more thorough accounting of the economic consequences of Coconino NF management.

Table 85. Estimated employment by program area by alternative

Program Area	Number of Jobs Contributed			
	Alternative A	Alternative B (modified)	Alternative C	Alternative D
Recreation	2,611	2,611	2,632	2,611
Grazing	330	330	330	330
Minerals	2	2	2	2
Timber	861 – 1,809	958 – 2,021	859 – 1,806	958 – 2,021
Ecosystem Restoration[1]	9	9	9	9
Payments to States and Counties	56	56	56	56
Forest Service Expenditures	508	508	508	508
Total	4,378 – 5,326	4,475 – 5,538	4,397 – 5,344	4,475 – 5,538

Source: MIG 2009

[1] Ecosystem restoration includes activities that are meant to improve ecosystem health and function. Specifically, these activities include: thinning, tree planting, weed spraying, mastication, prescribed burning, road work, road decommissioning, road closures, and culvert replacement. Only ecosystem restoration activities funded by external sources are included in this category to avoid double-counting with Forest Service expenditure-related employment and income.

Forest management accounts for approximately 0.15 percent of labor income in the study area. Forest management accounts for a smaller proportion of labor income than employment (0.15 percent and 0.20 percent, respectively). This suggests that forest-related employment is relatively low wage. The majority of forest-related employment and labor income come from recreation activities, which often support seasonal and youth employment. Therefore, wages in recreation-related sectors tend to be low compared to other service and professional sectors.

Table 86. Estimated labor income by program area by alternative

Program Area	Labor Income[1] Contributed			
	Alternative A	Alternative B (modified)	Alternative C	Alternative D
Recreation	$98,987,000	$98,987,000	$99,794,000	$98,987,000
Grazing	$5,198,000	$5,198,000	$5,198,000	$5,198,000
Minerals	$118,000	$118,000	$118,000	$118,000
Timber	$34,327,000 – $71,844,000	$38,176,000 - $80,240,000	$34,264,000 - $71,714,000	$38,176,000 - $80,240,000
Ecosystem Restoration	$312,000	$312,000	$312,000	$312,000
Payments to States and Counties	$2,796,000	$2,796,000	$2,796,000	$2,796,000
Forest Service Expenditures	$24,681,000	$24,681,000	$24,681,000	$24,681,000
Total	$166,419,000 - $203,936,000	$170,269,000 - $212,333,000	$167,163,000 - $204,612,000	$170,269,000 - $212,333,000

Source: MIG 2009

[1] Labor income includes employee compensation (i.e., salaries and wages paid to employees) and proprietor's income (i.e., business owners' income).

Table 87 provides the estimated annual forest product volumes available by alternative. These volumes are used to estimate the economic impact and financial efficiency of timber-related activities on the Coconino NF. This table will be referenced in alternative-specific descriptions of the economic consequences of forest product removal.

Table 87. Estimated annual forest product volumes by alternative

Forest product	Annual volumes							
	Alternative A		Alternative B (modified)		Alternative C		Alternative D	
	Low	High	Low	High	Low	High	Low	High
Harvest-Softwood 9+" Sawtimber (CCF)	70,533	152,247	78,893	170,510	70,397	151,964	78,893	170,510
Harvest-Softwood 5-9" Pulp (CCF)	11,362	23,476	12,713	26,299	11,339	23,432	12,713	26,299
Fuelwood (CCF)	10,625	10,625	10,625	10,625	10,625	10,625	10,625	10,625
Biomass (Green tons)	366,520	366,520	366,520	366,520	366,520	366,520	366,520	366,520

Source: Coconino NF Silviculture Staff

Common to All Alternatives

Under all alternatives, 133,924 head months of livestock would be permitted for grazing (119,177 for cattle and horses and 14,747 for sheep and goats). However, actual use would vary based on local forage and market conditions. Current actual utilization is 91,394 head months (76,647 for cattle and horses and 14,747 for sheep and goats). Based on permitted head months, approximately 330 jobs and $5.2 million in labor income are supported by grazing on the Coconino NF annually (table 85 and table 86). Current utilization supports 236 jobs and $3.8 million in labor income.

Stone, sand and gravel, and gypsum are removed from the Coconino NF. The quantities removed are not expected to differ between alternatives. Under all alternatives, mineral activities on the Coconino NF would support approximately 2 jobs and $118,000 in labor income, annually (table 85 and table 86).

Approximately 1,400 acres of the Coconino NF would be thinned annually using funds from external sources (outside the Coconino NF appropriated budget). These activities are expected to support approximately 9 jobs and $312,000 in labor income annually (table 85 and table 86). The economic impact of ecosystem restoration activities (as per IMPLAN Model[53]) funded through the Coconino NF is captured in the Forest Service Expenditures section.

As noted in table 84, the Coconino NF makes payments to local governments through Payments in Lieu of Taxes and Secure Rural Schools and Community Self-Determination Act. These payments would support approximately 56 jobs and $2.8 million in labor income annually under all alternatives. In addition, Coconino NF salary and nonsalary (e.g., office equipment) expenditures support approximately 508 jobs and $24.7 million in labor income in the local economy annually (table 85 and table 86).

Alternative A

Alternative A would continue Coconino NF management according to the 1987 plan, as amended. Management actions under alternative A are expected to support between 4,378 and 5,326 jobs and between approximately $166.4 and $203.9 million in labor income in the local economy.

Approximately 2.8 million people visit the Coconino NF annually for a variety of recreational activities; 57 percent of these visits originate outside of the local area. The expenditures of nonlocal visitors to the Coconino NF would support approximately 2,611 jobs and $99.0 million in labor income annually (table 85 and table 86).

Alternative A would likely have the lowest forest product removal volume among the considered alternatives (as per IMPLAN Model[54]). Based on the estimated annual forest product volumes listed in table 87, forest product removal under alternative A would support between 861 and 1,809 jobs and between $34.3 and $71.8 million in labor income in the local economy annually (table 85 and table 86).

Alternative B (modified)

Management actions under alternative B (modified) are expected to support between 4,475 and 5,538 jobs and between $170.3 and $212.3 million in labor income in the local economy.

Visitation to the Coconino NF for recreation would not be expected to differ from alternative A. Therefore, alternative B (modified) would support approximately 2,611 jobs and $99.0 million in labor income in the local economy, annually.

Alternative B (modified) would be expected to have a higher forest product removal volume than alternative A and would, therefore, increase local employment and labor income related to timber activities on the Coconino NF. Based on the estimated annual forest product volumes listed in table 87, forest product removal under alternative B (modified) would support between 958 and 2,021 jobs and between $38.2 and $80.2 million in labor income in the local economy annually (table 85 and table 86).

Alternative C

Management actions under alternative C are expected to support between 4,397 and 5,344 jobs and between $167.2 and $204.6 million in labor income in the local economy.

Due to an increase in special area acreage (identified in table 91), alternative C would be expected to slightly increase the number of nonlocal visitors to the Coconino NF for recreational activities annually.

[53] A potentially wide range of actions falls under ecosystem restoration, but in this context it specifically relates to mechanical thinning treatments on the Coconino NF that are externally funded.
[54] Model calculations are based on the timber allowable sale quantity, which may include timber sold as part of restoration-oriented activities.

Therefore, the economic contribution of recreation on the forest would increase to 2,632 jobs and $99.8 million in labor income annually (table 85 and table 86).

The average estimated annual forest product volume removal is lowest under alternative C. Alternative C would support between 859 and 1,806 jobs and between $34.3 and $71.7 million in labor income in the local economy, annually (table 85 and table 86). This is similar to the estimated employment and labor income supported by forest product harvesting under alternative A.

Alternative D

Like alternative B (modified), management actions under alternative D are expected to support between 4,475 and 5,538 jobs and between $170.3 and $212.3 million in labor income in the local economy.

Coconino NF visitation for recreational activities is not expected to change under alternative D. Therefore, alternative D would support approximately 2,611 jobs and $99.0 million in labor income in the local economy annually (table 85 and table 86).

Alternative D would be expected to have identical estimated forest product volumes to alternative B (modified). Therefore, alternative D would also support between 958 and 2,021 jobs and between $38.2 and $80.2 million in labor income in the local economy annually (table 85 and table 86).

Summary of All Alternatives

Alternative A would be expected to provide the lowest levels of employment and labor income to the local economy. Alternatives B (modified), C, and D have the highest expected levels of employment and income, mainly due to increased timber harvesting. Otherwise, the levels of employment and income for the other program areas remain constant across all alternatives because the economic impacts modeling did not reflect changes in demands for those goods and service between alternatives. For individuals who primarily value the Coconino NF for its contribution to the local economy, these alternatives would likely be favored. Alternatives B (modified) and D would provide equivalent employment and income—slightly below alternative C.

The annual forest products volume is similar across all alternatives, except for timber harvest (table 85). Alternative A would provide the least amount of timber harvest. Alternatives B (modified), C, and D would permit higher levels of forest product removal than alternative A.

Due to the increased volume of estimated annual timber harvest, alternatives B (modified), C, and D provide higher timber-related employment and income than alternative A.

Financial Efficiency Analysis

Financial efficiency analysis is a type of cost/benefit analysis used below to compare Coconino NF expenditures and revenues throughout the life of the plan (see Methodology Appendix C – Socioeconomic Analysis section for further details). Table 88 presents the estimated annual Coconino NF expenditures by program area. These figures are based on average expenditures over three fiscal years (FY 2008 through FY 2010). Future expenditures are uncertain and are heavily dependent on Federal budget allocations.

Table 88. Estimated annual Coconino NF program expenditures, by alternative (FY 2008 to FY 2010)

Program	Alternative A	Alternative B (modified)	Alternative C	Alternative D
Range	$588,091	$588,091	$588,091	$588,091
Recreation	$3,153,892	$3,153,892	$3,153,892	$3,153,892
Minerals	$115,369	$115,369	$115,369	$115,369
Timber	$1,215,002	$1,215,002	$1,215,002	$1,215,002
Non-Recreation Special Uses	$273,792	$273,792	$273,792	$273,792

Source: Coconino NF Budget Staff

Table 89 shows the estimated annual Coconino NF revenues by program area. Where available, these figures are based on average revenues over three fiscal years (FY 2008 through FY 2010). When three years of data were unavailable, the most recent available year has been used. Changes in estimated revenue for timber are based on estimated change in the allowable sale quantity of sawtimber under each alternative.

Table 89. Estimated annual Coconino NF program revenue, by alternative (FY 2008 to FY 2010)

Program	Alternative A	Alternative B (modified)	Alternative C	Alternative D
Range	$180,797	$180,797	$180,797	$180,797
Recreation	$1,809,016	$1,809,016	$1,809,016	$1,809,016
Minerals	$17,813	$17,813	$17,813	$17,813
Timber	$1,198,717	$1,333,166	$1,189,040	$1,333,166
Non-Recreation Special Uses	$325,776	$325,776	$325,776	$325,776

Source: Coconino NF Resource Specialists

Table 90 lists present estimated net value by program area and alternative. Present net value is the difference between program revenues (benefits) and program expenditures (costs) over a 15-year period, using a 4 percent discount rate. The annual expenditures presented in table 88 were summed over 15 years using a 4 percent discount rate (so that 1 dollar today is valued higher than 1 dollar in 10 years). The sum of the discounted annual expenditures represents the present value of costs. The same exercise was conducted using the annual program revenues presented in table 89. The sum of the discounted annual revenues represents the present value of benefits. The difference between the present value of costs and the present value of benefits of a particular program area or resource is present net value. The higher the present net value, the more financially efficient the alternative.

Table 90. Estimated present net value by alternative and program area (15-year period)

Program	Alternative A	Alternative B (modified)	Alternative C	Alternative D
Range	$(4,935,746)	$(4,935,746)	$(4,935,746)	$(4,935,746)
Recreation	$(16,297,728)	$(16,297,728)	$(16,297,728)	$(16,297,728)
Minerals	$(1,182,221)	$(1,182,221)	$(1,182,221)	$(1,182,221)
Timber	$(197,348)	$1,431,957	$(314,618)	$1,431,957
Non-Recreation Special Uses	$629,962	$629,962	$629,962	$629,962
Total Present Net Value	$(21,983,082)	$(20,353,777)	$(22,100,352)	$(20,353,777)

Source: QuickSilver[1] 2010

[1] QuickSilver is a Forest Service program for economic analysis of long-term, on-the-ground resource management projects. It provides a consistent benefit/cost efficiency analysis framework to determine if one management action costs less, or has a better payoff than others.

Note: Figures in parenthesis indicate a negative number

Alternative A

As shown in table 90, the present net value of alternative A is estimated to be a negative $21,983,082, based on the Coconino NF's annual program revenues and expenditures. This is the lowest present net value among the considered alternatives. Alternative A has the lowest present net value primarily due to the lower expected volume of forest product removal from the Coconino NF. Other programs make larger or smaller contributions to the present net value, but they do vary by alternative. The forest would receive the lowest amount of timber-related revenue under alternative A, yet the costs of administering timber resources are not expected to differ among alternatives. As discussed above, this assumption arose from the uncertainty of future budgets. The present net value for the other programs areas remain constant across all alternatives because the financial efficiency modeling did not reflect changes in demands for those goods and service between alternatives.

Alternative B (modified)

As shown in table 90, the present net value of alternative B (modified) is estimated to be a negative $20,353,777 based on the Coconino NF's annual program revenues and expenditures. Alternative B (modified) has a higher present net value than alternatives A and C as a result of an expected increase in timber-related revenue and no expected changes in Coconino NF timber management costs. Other programs make larger or smaller contributions to the present net value, but they do vary by alternative.

Alternative C

As shown in table 90, the present net value of alternative C is estimated to be a negative $22,100,352, based on the Coconino NF's annual program revenues and expenditures. This is the lowest present net value (least financially efficient) among the considered alternatives. Alternative C has the lowest present net value due to the smallest expected timber-related revenue among the alternatives. Other programs make larger or smaller contributions to the present net value, but they do vary by alternative.

Alternative D

As shown in table 90, the present net value of alternative D is estimated to be a negative $20,353,777, based on the Coconino NF's annual program revenues and expenditures. This is a higher present net value (more financially efficient) than alternatives A and C. Like alternative B (modified), which has the same estimated present net value, alternative D has a higher present net value than alternatives A and C as a result of expected increases in timber-related revenue and no expected changes in Coconino NF timber

management costs. Other programs make larger or smaller contributions to the present net value, but they do vary by alternative.

Summary of All Alternatives

The difference in present net value between alternative A and the other alternatives arises largely due to changes in expected timber revenue. Otherwise, the estimates for the present net value for the other programs areas remain constant across all alternatives. Whereas Forest Service timber management-related expenditures are not expected to change, the volume of available timber for harvest increases between alternative A and alternatives B (modified), C, and D, which would increase the timber-related revenue that the Coconino NF collects. Over a 15-year period, this translates to a large difference in present net value. The assumption of fixed budgets arose from the uncertainty of future budgets. However, increased timber harvests under alternatives B (modified), C, and D would likely require additional expenditures beyond what is estimated here. Therefore, the difference in present net value between alternative A and the other alternatives is likely overstated.

Social Consequences

Nonmarket Values

Area residents and visitors attach numerous values to the Coconino NF. For some, NFS lands provide economic opportunities in rural communities. To others, the Coconino NF is valued for leisure. These generalized classifications, however, do not capture the nuances of peoples' values. Furthermore, many individuals are likely to rely on the Coconino NF for both economic opportunities and leisure pursuits.

The Economic and Social Sustainability Assessment prepared for this plan revision effort identified a number of social values associated with Southwestern Region forests, including: (1) preservation of open space, (2) protection of ecosystem service and other forest-related amenity values, (3) economic opportunities from both commodity and noncommodity sources, (4) accessible and varied outdoor recreation opportunities, and (5) traditional tribal uses, such as gathering boughs and visiting sacred sites (USDA Forest Service 2008a). Timber management and lands recommended for wilderness are the main sources of potential social and economic consequences between alternatives.

As described above, the study area has a great deal of publicly owned lands. This suggests that Forest Service decisions, and other Federal actions, may have a substantial effect on social and economic well-being of the communities in the study area, such as providing recreational opportunities, clean water and healthy ecosystems, and employment. The estimated change in timber-related employment and income between alternative A and alternatives B (modified), C, and D will affect economic well-being in the region. Increasing employment opportunities in the timber sector may attract or retain residents in the study area.

Table 91 lists the acres likely to support nonmarket values by alternative. Individuals who value resource protection above resource use are likely to derive benefit from the recommendation of additional lands for wilderness, regardless of intention to recreate in the wilderness. In 2005, approximately 6.9 percent of visits to the Coconino NF were to designated wilderness areas; by 2010, 10.6 percent of visits to the Coconino NF were to designated wilderness areas. Furthermore, between 2005 and 2010, Coconino NF wilderness visitation increased from 380,000 to 500,000 annual site visits, despite an overall decrease in Coconino NF visitation (USDA Forest Service 2016n). Wilderness areas also have nonrecreation values, such as the promotion of forest health and ecosystem services. Loomis and Richardson (2001) identify eight values related to wilderness and other protected lands: (1) recreation benefits, (2) community effects, (3) passive-use values, (4) scientific values, (5) biodiversity values, (6) offsite benefits, (7) ecological services, and (8) educational values. Alternative C is expected to appeal to people and groups

who seek additional primitive recreation opportunities and/or the protection of forest resources, as it has the greatest acreage with wilderness-related values. Alternative B (modified) provides the second highest acreage, followed by alternative D and alternative A.

Table 91. Nonmarket values, acres by alternative (percentages indicate percent of total Coconino National Forest acreage)

Wilderness-related Values	Alternative A	Alternative B (modified)	Alternative C	Alternative D
Special Areas[1] (in acres)	163,906 (8.9%)	180,965 (9.8%)	266,828 (14.5%)	166,198 (9.0%)
Visual Quality Objective: Preservation value Scenic Integrity Objective: Very High value (in acres)	156,491 (8.5%)	222,256 (12.1%)	222,256 (12.1%)	222,256 (12.1%)
Recreation Opportunity Spectrum: Primitive value (in acres)	158,608 (8.6%)	206,011 (11.2%)	285,608 (15.5%)	191,244 (10.4%)
Eligible Wild and Scenic River Segments (in acres)	16,312 (0.9%)	16,312 (0.9%)	16,312 (0.9%)	16,312 (0.9%)

Source: Coconino NF Resource Specialists

[1] This includes existing and recommended wilderness areas, other special areas, environmental study areas, the Cottonwood Basin Geological Area, and proposed research natural areas.

Alternative A

Table 91 lists Coconino NF acres that would promote nonmarket and ecosystem service values. Alternative A has the fewest acres in support of these values among the considered alternatives.

Alternative B (modified)

Table 91 lists Coconino NF acres that would promote nonmarket and ecosystem service values. Alternative B (modified) has the second highest in support of nonmarket values among the considered alternatives.

Alternative C

Table 91 lists Coconino NF acres that would promote nonmarket and ecosystem service values. Alternative C has the highest acres in support of these values among the considered alternatives.

Alternative D

Table 91 lists Coconino NF acres that would promote nonmarket and ecosystem service values. Alternative D has the second fewest acres in support of these values among the considered alternatives.

Environmental Justice

Common to All Alternatives

As discussed above in the Affected Environment section, the Environmental Justice analysis finds that the study area has large shares of American Indian residents as well as high poverty rates, particularly in Coconino County. These findings raise the likelihood of observing disproportionate adverse effects to low income and/or minority residents. However, a review of the decisions to be made under the alternatives does not identify adverse effects to low income and minority residents. Because all alternatives would continue to support similar levels of employment and income, none of the decisions are expected to exacerbate the poverty rate or disproportionately worsen the economic well-being of low-income individuals. Under all alternatives, American Indian residents would be able to gather forest products and visit sacred sites. None of the alternatives would have environmental justice consequences because none of them are expected to disproportionately adversely affect racial and/or ethnic minority individuals.

Cumulative Effects

Common to All Alternatives

The timeframe for the socioeconomic cumulative effects analysis is the next 10 to 15 years, and the geographic scope is the three-county region[55] identified in the Affected Environment section. This analysis considers how past, present, and reasonably foreseeable future actions on lands throughout the region may interact with decisions made under the proposed plan to affect the social and economic environment. The social and economic analysis of the alternatives is unique among the resources and uses in that the effects occur primarily off the forest. In this way, the indirect effects described above are cumulative in nature—they evaluate the role of Forest Service decisions under the alternatives both on and off the Coconino NF. However, the indirect effects analysis does not address how actions taken on adjacent lands will affect the social and economic consequences of the alternatives.

Ecosystem restoration would occur under all alternatives; it is expressly emphasized in alternatives B (modified), C, and D. Current and proposed plans on adjacent NFS lands also emphasize ecosystem restoration. The scale of the proposed treatments (on Coconino NF and adjacent lands) is expected to draw new forest product harvesting and processing firms to the region. The timber and ecosystem restoration estimates presented in the Environmental Consequences section are based on a static model of the economy. However, if additional firms locate in the area due to regionwide restoration efforts, the local economic impact of activities to occur under the alternatives would increase.

The recreation-related effects identified in the social and economic Environmental Consequences section may be influenced by trends and activities that occur off the forest. The proximity of the Coconino NF to other popular recreation sites, particularly the Grand Canyon, drives high rates of tourism throughout the region. In fiscal year 2010, Arizona State Parks closed 13 of its 28 parks. Although most of these parks have reopened, a number are open on a reduced schedule. Furthermore, the possibility of future closures remains due to ongoing budget uncertainty. The reduction in recreation opportunities on State lands may increase demand for recreation on the Coconino NF. All alternatives include plan direction that supports diverse recreational opportunities on the forests. Increased recreational use on the Coconino NF would lead to a higher economic impact than predicted in the indirect effects discussion. However, other adjacent lands (Bureau of Land Management, National Park Service, and other NFS lands) continue to emphasize the provision of recreation opportunities in their land and resource management plans, too. These actions may counterbalance the consequences of reduced opportunities elsewhere in the state.

The Coconino NF may provide infrastructure to support reasonably foreseeable alternative energy development in the region under all alternatives. Growing interest in renewable energy sources, particularly geothermal development, could lead to more employment in these sectors throughout the region. The Department of the Interior is emphasizing alternative energy as a management priority. The Bureau of Land Management's Solar Programmatic Environmental Impact Statement (Solar PEIS) identified lands in the region as having a high potential for solar development. The Centennial West power corridor for alternative energy would expand alternative energy development from New Mexico to California.

Short-term Uses and Long-term Productivity

NEPA requires consideration of "the relationship between short-term uses of man's environment and the maintenance and enhancement of long-term productivity" (40 CFR 1502.16).

[55] Coconino, Maricopa, and Yavapai Counties.

Short-term uses are those expected to occur on the Coconino NF over the next 10 to 15 years. These uses include, but are not limited to, recreation, grazing, mineral development, timber harvest, and prescribed burning. Although these uses are not directly implemented by the forest plan, the potential for these uses are described in forest plan desired conditions and objectives, both at the forestwide and management area levels (see chapters 2 and 3 in the forest plan) and evaluated throughout the various sections of this chapter.

Long-term productivity refers to the capability of the land to provide resource outputs beyond the life of the forest plan. Minimum management requirements prescribed by the forestwide standards and guidelines would be met under all alternatives. Minimum requirements assure that long-term productivity of the land would not be impaired by short-term uses.

Monitoring plans are a part of all alternatives. One purpose of monitoring is to assure that the long-term productivity of the land is maintained or improved. If monitoring and subsequent evaluation indicates that forestwide standards and guidelines are insufficient to protect long-term productivity, the forest plan would be amended accordingly.

Although all the alternatives were designed to maintain long-term productivity, there are differences between alternatives in the long-term availability or condition of resources. There may also be differences among alternatives in the expenditures necessary to maintain desired conditions. Notable differences between short-term use and long-term productivity are summarized below.

Air Quality

The short-term increases in impacts to visibility and air quality are offset by the long-term improvement in the vegetation conditions across the forest and the decreased risk of uncharacteristic fire in alternatives B (modified) and D, and to a lesser degree in alternative C. Alternative A has restrictions that protect air quality from low smoke impacts over the short term, but would result in smoke from uncharacteristic wildfire that would far exceed the levels that are acceptable to protect human health.

Vegetation

Modeled vegetation types within all alternatives would move toward desired conditions by reducing the level of departure from reference conditions. At the proposed levels of treatment, each alternative would see marked improvement over existing conditions. The rate of improvement tends to slow down for all alternatives analyzed between 15 and 50 years, but improvement generally continues over this time frame. The only exception is with Pinyon Juniper with Grass where the level of departure starts back on a negative trend between years 15 and 50.

Scenic Resources

Many activities occurring under an alternative, although they may have some short-term negative impacts on scenery, may also begin to move the landscape toward the desired landscape character. Effects that would move the vegetation toward the desired landscape character are usually beneficial to scenic resources in the long term. These beneficial effects are often realized over a long period of time, but lead to the lasting sustainability of valued scenery attributes. For example, tree thinning may have short-term effects of ground disturbance, stumps, and slash, but in the long term, if properly mitigated for scenery, may provide visual access into the forest and promote large tree growth and a smooth herbaceous ground cover. In the long term, the removal of some trees, dependent on scale and intensity of treatment, may be a beneficial effect for scenery when the resulting landscape is part of the desired landscape character. Additionally, those activities that restore fire-adapted ecosystems, when properly mitigated for scenery, move the landscape toward the desired landscape character and lead to the long-term stability of valued

scenery attributes by reducing the risk of losing the valued landscape attributes to a wildfire burning outside the historic disturbance regime.

Mineral Resources

Activities associated with mineral resource development and production including locatable minerals, leasable minerals, and common variety mineral materials may have adverse consequences on the environment while providing a needed mineral resource. Environmental consequences are described in the Mineral Resources section of this chapter. With reclamation during and at the end stages of operations, the disturbed areas can often be partly to fully restored to productive forest or rangelands over time. Buildings and other facilities can also be removed at the end of operations.

Mineral production activities are a fundamental part of our multiple-use mandates for national forests and grasslands and serve to satisfy our mineral needs for industries, homeland security, and the environment. Some mineral production is renewable such as geothermal. Locatable minerals and common variety mineral materials are finite resources.

Infrastructure and Facilities

Each alternative has roads contained within areas that change ROS classifications from motorized to non-motorized. These roads would become inaccessible to all motor vehicles due to the changing ROS designation of roads within wilderness, wildlife habitat, or other special interest management areas. In the short term, this would affect public access to portions of the forest where these designations have changed from motorized to non-motorized. The long-term implications of these changes would mean less maintenance for roads in these non-motorized areas and more focus on the remaining roads for user comfort and safety.

Table 92 shows the changes of primitive and semi-primitive non-motorized road mileage in reference to the road ROS classification among alternatives. There is no change in total road mileage; however, the road mileage contained within non-motorized areas (primitive and semi-primitive non-motorized) alter significantly between alternatives. These road mileages would potentially be considered for decommissioning or closure over the life of the plan to move toward the desired ROS for the area.

Table 92. Road mileage within non-motorized areas by alternative

Type of Use	Primitive	Semi-primitive Non-motorized	Total
Alternative A			
Public Use	20	36	36
Admin Use	28	58	86
Total			122
Alternative B (modified)			
Public Use	0.6	2	2.6
Admin Use	12	190	202
Total			204.6
Alternative C			
Public Use	12	2	14
Admin Use	17	186	203
Total			217
Alternative D			
Public Use	0.6	2	2.6
Admin Use	12	190	204.6
Total			748.2

Lands

Land adjustment actions typically have long-term productivity effects. NFS land can be conveyed to provide for needed community infrastructure and could be lost for any other resource value or productivity. Acquisition of lands of other ownership through land exchanges or purchase cases would benefit long-term productivity by working toward acquiring key resource values and isolated parcels of private land that, if developed, could impact neighboring forest resources for the foreseeable future. Development of inholdings results in loss of long-term productivity of surrounding NFS lands due to resulting infrastructure needs and other approved or unauthorized uses.

Special uses of NFS lands may have adverse environmental consequences on some resources (e.g., construction of authorized facilities such as a communications site tower) in the short and long term. Short-term environmental consequences include increased human activity, such as motorized traffic, noise from construction equipment, temporary roads, ground disturbance, temporary loss of wildlife habitat, and impacts to scenery resources during construction of the authorized facilities.

Long-term environmental consequences include operation and maintenance of the authorized facilities over the life of the facility in some cases the foreseeable future. Utility lines would likely be in place far beyond the duration of the plan. Operation and maintenance activities may include increased human activity and noise, motorized vehicle traffic, additional ground disturbance, recurring disturbance to wildlife and long-term visible structures that impact scenery values. Determination and implementation of mitigation measures and design may lessen environmental consequences.

Over the long term, the public and communities should benefit from services that are provided on Federal lands. Authorizations that are a long-term commitment (more than 5 years) and permit some type of construction or ground disturbance or alter the landscape would encumber NFS lands for the term of the

authorizations and most likely for the foreseeable future. Few authorized constructed features are fully removed or rehabilitated.

Unavoidable Adverse Effects

Decisions made in a forest plan do not represent actual irreversible or irretrievable commitment of resources (see next section). For a detailed discussion of types of effects expected from future activities, see specific topic areas in this chapter.

The land management plan provides a programmatic framework that guides site-specific actions, but does not authorize, fund, or carry out any project or activity. Before any ground-disturbing actions take place, they must be authorized in a subsequent environmental analysis. Therefore, none of the alternatives cause unavoidable adverse impacts. The application of forest plan standards and resource protection measures would limit the extent and duration of any adverse environmental impacts. Mechanisms are in place to monitor and use adaptive management principles to help alleviate any unanticipated impacts that need to be addressed singularly or cumulatively.

Any activities occurring under an alternative, although they may have some short-term negative impacts on scenery, also may begin to move the landscape toward the desired landscape character. Effects that would move the vegetation toward the desired landscape character are usually beneficial to scenic resources in the long term. These beneficial effects are often realized over a long period of time, but lead to the lasting sustainability of valued scenery attributes. For example, tree thinning may have short-term effects of ground disturbance, stumps, and slash, but in the long term, if properly mitigated for scenery, may provide visual access into the forest and promote large tree growth and a smooth herbaceous ground cover. In the long term, the removal of some trees, dependent on scale and intensity of treatment, may be a beneficial effect for scenery when the resulting landscape is part of the desired landscape character. Additionally, those activities that restore fire-adapted ecosystems, when properly mitigated for scenery, move the landscape toward the desired landscape character and lead to the long-term stability of valued scenery attributes by reducing the risk of losing the valued landscape attributes to a wildfire burning outside the historic disturbance regime.

Irreversible and Irretrievable Commitments of Resources

Irreversible commitments of resources are those that cannot be regained, such as the extinction of a species or the removal of mined ore. Irretrievable commitments are those that are lost for a period of time such as the temporary loss of timber productivity in forested areas that are kept clear for use as a power line rights-of-way or road. These land management plans (forest plans) are programmatic in nature, and as such, do not make decisions to authorize specific activities. There are no irreversible and irretrievable commitments of resources resulting from any of the alternatives.

Adaptive Management

All alternatives assume the use of adaptive management principles. Forest Service decisions are made as part of an ongoing process. The forest plan identifies desired conditions to which management activities should make progress toward. Monitoring the results of activities would provide a flow of information that may indicate the needs to change a course of action or the land management plan. Scientific findings and the needs of society may also indicate the need to adapt resource management to new information. These updates and revisions would provide the ability to adapt our activities to changing conditions.

Other Required Disclosures

The regulations for implementing the National Environmental Policy Act at 40 CFR 1502.25(a) directs "to the fullest extent possible, agencies shall prepare draft environmental impact statements concurrently with and integrated with …other environmental review laws and executive orders." As a proposed Federal project, the proposed plan decisions are subject to compliance with other Federal and State laws. Determinations and decisions made in the proposed plan have been evaluated in the context of relevant laws and executive orders. Various State and Federal agencies collaborated throughout the development of the proposed plan. The following actions have been taken to document and ensure compliance with laws that require consultation and/or concurrence with other Federal agencies.

- Endangered Species Act, Section 7: Consultation with the U.S. Department of the Interior, Fish and Wildlife Service, regarding federally listed threatened, endangered, and proposed species and designated and proposed critical habitat is in progress.
- National Historic Preservation Act: Consultation with the Arizona State Historic Preservation Officer is mandated by Section 106 of the National Historic Preservation Act. The Southwestern Region also subscribes to a programmatic agreement with the Arizona State Historic Preservation Office for ways in which consultation can be conducted. The various appendices of the programmatic agreement are particularly directed to Southwestern Region projects and issues.
- Government-to-government consultation was completed with Native American tribes who have aboriginal territory within the lands now part of the Coronado National Forest, as required by the National Historic Preservation Act; Executive Orders 13007 and 13175; and the 2003 First Amended Programmatic Agreement cited above.

Volume I Index

Acronyms, ix
Administrative facilities, 425
Air quality, 51–66, 484
  other forest activities, 62–63
  smoke management, 52–53, 54–61
  visibility, 53
Alligator juniper, 191, 280
Allowable sale quantity (ASQ), 394
Alpine Tundra, 188, 274–75
Alternative A (1987 plan), 23
Alternative B (modified), 24–27
Alternative C, 27–28
Alternative D, 28–29
Alternatives, 13–48
  comparison, 29–42
  considered in detail, 21
  eliminated from detailed study, 18–21
  process used to develop, 13–17
Aspen, 189, 275–77
Assumptions, 49
Background, 6
Biophysical features, 154–74
Blue spruce, 191, 281
Botanical and geological areas, 338–44
Changes from DEIS, 2–5
Clean Air Act, 51
Climate change, 284–90
  affected environment, 284
  cumulative effects, 289
  environmental consequences, 286
Common to all alternatives, 21
Cumulative effects
  air quality, 63–66
  common to all resources, 50
  riparian areas, 88–89
  soil, 88–89
  water, 88–89
Decision framework, 9
Desert Communities, 181, 247–49
Desired conditions, 22
Document Structure, 1–2
Ecological response units (ERUs), 181–89
Economic diversity, 470–73
Effects
  summary of, 43–48
Employment and income, 468–70
Environmental justice, 465–68, 482
Environmental study areas, 344–46
Facilities, 416–27
Financial efficiency analysis, 478–81
Fire, 174–284
  frequency and departure, 175–80
  snags, 180
Fire management, 386–93
  cumulative effects, 392–93
  Wilderness, 389–91
  wildland-urban interface, 387–89
Forest products, 393–401
  cumulative effects, 400–401
  environmental consequences, 395–400
Forest road system, 416, 417–19
Gambel oak, 190, 278
Geological features, 154–67
  caves and karst, 156
  cliffs, 156
  cumulative effects, 166
  environmental consequences, 156–65
  talus slopes, 156
Great Basin Grassland, 182, 252–56
Heritage resources, 402–13
  cumulative effects, 411–13
  environmental consequences, 403–11
Infrastructure and facilities, 416–27, 485
  cumulative effects, 426
  environmental consequences, 417–25
Interior Chaparral, 183, 258–61
Inventoried roadless areas, 334
Issues, 11–12
  already decided, 12
  recreation, 11
  use/management, 11
  wildlife or ecosystem, 11
Landownership, 429–32
Lands, 486
  cumulative effects, 440–41
Lands and special uses, 427–42
Leasable minerals, 370
Livestock grazing, 443–59
  cumulative effects, 456–59
  current management, 445

environmental consequences, 445–56
Location, 5
Long-term sustained yield capacity (LTSYC), 394
Management areas, 22
Maple, 190, 277
Mineral materials, 368
Mineral resources, 364–86, 485
cumulative effects, 383–86
leasable minerals, 370
mineral materials, 368
Mineral withdrawals, 371, 379
Mining, 364–68
Mixed Conifer with Frequent Fire, 186, 169–73
Mixed Conifer with Infrequent Fire, 187, 268–71
Monitoring strategy, 22
Montane/Subalpine Grassland, 183, 256–58
National trails, 335–38
National Visitor Use Monitoring (NVUM), 297
Needs for Change, 6–8
Paleontological resources, 13–17
cumulative effects, 174
environmental consequences, 169–73
Payments to states and counties, 474
Pinyon-Juniper Evergreen Shrub, 184, 261–64
Pinyon-Juniper with Grass, 184, 239–47
Pinyon-Juniper Woodland, 185, 264–68
Ponderosa Pine, 185, 211–25
Preferred alternative, 29
Proposed action, 8–9
Proposed Revised Plan. *See* Alternative B (modified)
Public involvement, 10–11
Recreation, 290–325
activities, 297–301
cumulative effects, 323–25
facilities, 297–301
non-motorized and motorized, 297–310
setting, 290–97
special uses, 319–23
trails, 310–16
Recreation opportunity spectrum (ROS), 290–92, 419
Renewable Resources Planning Act Program, 18
Research natural areas, 338–44
Revision topics, 6–8
Riparian areas, 89–111
environmental consequences, 99–111
riparian forest types, 99–105
seeps, 98
springs, 98
Streams, 99–105
threats, 91–96
wetlands, 98
Roadless Area Conservation Rule, 22
Scenic resources, 346–63, 484
Scenic roads, 335–38
Seeps, 98
Semi-desert Grassland, 182, 249–52
Smoke
management, 52–53
Social consequences, 481–82
Socioeconomic analysis, 459–83
affected environment, 461–65
cumulative effects, 483
environmental consequences, 474–78
Soil, 111–53
biological crusts, 114, 118, 128
coarse woody debris, 118, 128
condition, 111–14
environmental consequences, 115–53
lead contamination, 126, 132, 134
livestock grazing, 119, 129, 133
minerals, 121, 129
plan language, 133
productivity, 111–14
roads, 124, 130, 133
ROS/Suitability, 125, 132, 134, 135
uncharacteristic fire, 121, 129
water supply watersheds, 124, 131, 134
wilderness, 126, 132, 135
Special areas, 325–46
botanical and geological areas, 338–44
environmental study areas, 344–46
national trails, 335–38
research natural areas, 338–44
scenic roads, 335–38
Special uses
cumulative effects, 441–42
environmental consequences, 433–39
Springs, 98
environmental consequences, 107–11
Spruce-Fir, 188, 271–74
Summary, i
Trails, 310–16
Transportation suitability, 421–25
Tribal consultations, 10
Tribal relations, 413–16
Vegetation, 484

Vegetation and Fire, 174–284
  affected environment, 175–91
  cumulative effects, 191–281
  ecological response units, 181–89
  environmental consequences, 191–281
Verde Gypsum Mine, 386
Visibility, 53, 61
Water, 66–89
  groundwater, 69
  quality, 70–75
  quality categories, 72
  quantity, 70–75
  rights, 75
Watersheds, 66–89
Wetlands, 98
  environmental consequences, 106–7
Wild and scenic rivers, 325–34
Wilderness, 23, 325–34
Wilderness recreation opportunity spectrum (WOS), 292
Wildland-urban interface, 23